2013 MINNESOTA FIRE WEATHER OPERATING PLAN

NWS Offices
Signed by Mike Stewart, MIC NWS Duluth, MN

Chanhassen, Duluth, MN
Grand Forks, ND
Sioux Falls, Aberdeen, SD
La Crosse, WI

Land Management Agencies
Signed by Doug Ottosen MNICS Task Force Chairman

Minnesota Department of Natural Resources MN DNR
USDA Forest Service - Region 9 (Superior and Chippewa National Forests)
DOI US Fish and Wildlife Service
DOI National Park Service
DOI Bureau of Indian Affairs.

2013 MINNESOTA FIRE WEATHER OPERATING PLAN
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FIRE WEATHER OPERATING PLAN FOR MINNESOTA NATIONAL WEATHER SERVICE - FEBRUARY, 2013

INTRODUCTION

This document serves as the Minnesota Fire Weather Operating Plan (AOP) for the National Weather Service (NWS) and the interagency fire management community with fire management responsibility in Minnesota. The relationship between the NWS and land management agencies is established in the following documents:

- Interagency Agreement for Meteorological Services (National Agreement).
- Eastern Area Mobilization Guide
- NWS Directives 10-4 Series (See references in this document)

This AOP provides specific policy and procedure information used to provide forecast service to the fire management community in the State of Minnesota. In support of the Eastern Area Coordination Center, the EACC meteorologist will act as a liaison between the interagency fire management community and the NWS.

This Operating Plan is updated annually, and is reviewed by representatives of the NWS and each user agency prior to the onset of the spring fire season. All parties should have a copy of this plan available for reference purposes. Each fire management agency will be responsible for any duplication and further distribution of this plan to fire management personnel. The Operating Plan is also available in the Fire Weather section of NWS web sites.

SUMMARY OF UPDATES FOR 2013

- The IMET section was updated to remove reference to IMET stationed at the Minneapolis weather office with the retirement of Byron Paulson.
- The NWS Directory was updated to reflect personnel changes. The new Task Force Chairman is Doug Ottosen with the USFS.
- The St Croix RAWS site was added to the list of DNR owned stations and Duluth Forecast Points.

I. SERVICE AREA AND ORGANIZATIONAL DIRECTORY

The following NWS offices provide fire weather forecast service to the State of Minnesota:
See page 6 for a map of NWS forecast areas in Minnesota.

TWIN CITIES/CHANHASSEN NWS Forecast Office
1733 Lake Drive West
Chanhassen, MN 55317-8581
Operations Phone 952-361-6670
Web Address http://weather.gov/mpx
Backup office: NWS Duluth

Mike Griesinger	Fire Weather Focal Point	Michael.griesinger@noaa.gov
Dan Luna	Meteorologist-in-Charge	Daniel.luna@noaa.gov

DULUTH NWS Forecast Office
5027 Miller Trunk Highway
Duluth, MN 55811-1442
Operations Phone 218-729-6697
Web Address http://weather.gov/dlh
Backup office: NWS Twin Cities/Chanhassen

Amanda Graning	Fire Weather Focal Point	amanda.graning@noaa.gov
Geoff Grochocinski	Assistant F/W Focal Point	geoffrey.grochocinski@noaa.gov
Michael Stewart	Meteorologist-in-Charge	michael.stewart@noaa.gov

GRAND FORKS NWS Forecast Office
4797 Technology Circle
Grand Forks, ND 58203-0600
Operations Phone 701-795-5198
Web Address http://weather.gov/fgf
Backup office Bismarck, ND 701-250-4452

Al Voelker	Fire Weather Focal Point	al.voelker@noaa.gov
Brad Hopkins	Assistant F/W Focal Point	brad.hopkins@noaa.gov
Mark Frazier	Meteorologist-in-Charge	mark.frazier@noaa.gov

LA CROSSE NWS Forecast Office
N2788 County Road
La Crosse, WI 54601-3038
Operations Phone 608-784-8275
Web Address http://weather.gov/arx
Backup Office Des Moines, IA 515-270-4501

Dave Schmidt	Fire Weather Focal Point	dave.schmidt@noaa.gov
John Wetenkamp	Assistant F/W Focal Point	john.wetenkamp@noaa.gov
Glenn Lussky	Meteorologist-in-Charge	glenn.lussky@noaa.gov

SIOUX FALLS NWS Forecast Office
26 Weather Lane
Sioux Falls, SD 57104-0198
Operations Phone 605-330-4247
Web Address http://weather.gov/fsd
Backup Office Aberdeen, SD

Mike Fuhs	Fire Weather Focal Point	michael.fuhs@noaa.gov
Jeff Chapman	Assistant F/W Focal Point	jeffery.chapman@noaa.gov
Sally Pavlow Johnson	Meteorologist-in-Charge	sally.pavlow@noaa.gov

ABERDEEN NWS Forecast Office
824 Brown County 14 S.
Aberdeen, SD 57401
Operations Phone 605-225-0519
Web Address http://weather.gov/abr
Backup Office Sioux Falls, SD

Travis Tarver	Fire Weather Program Leader	travis.tarver@noaa.gov
James Scarlett	Meteorologist-in-Charge	james.scarlett@noaa.gov

OTHER IMPORTANT NWS CONTACTS
Larry Van Bussum, Natl F/W Ops Coord (NFWOC)
National Interagency Fire Center (NIFC)
3833 South Development Avenue, Bldg 3807
Boise, ID 83705-5354
e-mail larry.vanbussum@noaa.gov

Jennifer Zeltwanger
Regional Operational Services Meteorologist (ROSM)
National Weather Service,
Central Region Headquarters
7220 NW 101st Terrace
Kansas City, MO 64153
email Jennifer.zeltwanger@noaa.gov
Central Region web site http://weather.gov/crh

Heath Hockenberry
National Fire Weather Program Leader
National Weather Service
3833 South Development Ave.
Boise, ID 83705
email heath.hockenberry@noaa.gov

National Fire Weather web page http://fire.boi.noaa.gov

B. PARTICIPATING AGENCIES

1. DOC/NOAA - National Weather Service (offices listed in part I.A above.)
2. USDA Forest Service - Region 9 (Superior National Forest, Chippewa National Forest)
3. DOI National Park Service
4. DOI US Fish and Wildlife Service
5. DOI Bureau of Indian Affairs.
6. Minnesota Department of Natural Resources MNDNR

See Appendix A for a full listing of Agency contacts, addresses, and phone numbers.

II. SERVICES PROVIDED BY THE NATIONAL WEATHER SERVICE

A. BASIC SERVICES - This section describes the fire weather products and services provided by the NWS as described in National Weather Service Directive NWSI 10-401. Significant changes to the services provided in Minnesota are generally coordinated at the annual Minnesota State Fire Weather Meeting. Since there are no full-time forecasters devoted solely to fire weather, these duties are scheduled among other warning and forecast responsibilities. However, spot forecasts for wildfires are treated with a high priority.

1. ROUTINE FIRE WEATHER FORECASTS

Forecasts usually begin in early April in southern Minnesota, but have begun as early as mid March. Forecasts are initiated farther north as the snow melts. User agencies are responsible for requesting NWS offices serving their area to begin forecast service. See Figure 1 for the NWS offices and their areas of forecast responsibility. Fire season generally ends across Minnesota in November, but has been extended as late as mid-December. User agencies will coordinate with the appropriate NWS office to determine when forecasts are no longer needed.

Access to Forecasts - Forecasts are available via WIMS, NWS web sites, or on web sites maintained by Predictive Services at the GACCs.

Types of Forecasts;

1. Fire Weather Planning Forecast (FWF)
2. National Fire Danger Rating System Forecast (NFDRS) (FWM)
3. Spot Forecasts (FWS)
4. Fire Weather Watches and Red Flag Warnings (RFW).

2. FIRE WEATHER PLANNING FORECAST

During fire season, **Fire Weather Planning Forecasts** are issued twice daily - once by 0700 with the afternoon issuance by 1500, if possible. During the summer months (June, July, thru mid August) NWS Sioux Falls will only provide a morning forecast issuance, unless requested by land managers to resume/continue the afternoon Planning Forecast. Forecasts are updated if a Fire Weather Watch or Red Flag Warning is issued or cancelled, or the current forecast does not adequately describe expected weather conditions.

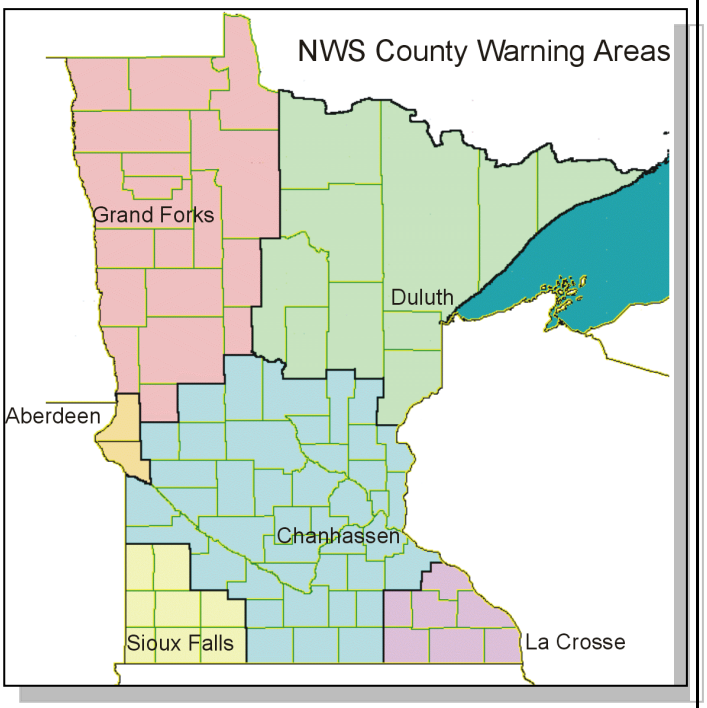

Figure 1 . County Warning Areas (CWA) for NWS offices serving Minnesota.

Fire Weather Planning Forecasts are issued for 98 fire weather zones. These zones, shown in Figure 2 generally follow county lines. Some of the larger counties may be subdivided into smaller zones. Appendix E has a list of zone numbers, county and key city names, as well as weather reporting stations.

Morning narrative forecasts are written for three forecast periods (TODAY, TONIGHT, TOMORROW). Afternoon narrative forecasts are written for (TONIGHT, TOMORROW, TOMORROW NIGHT, NEXT DAY). A forecast for days 3 through 7 is appended to each forecast group. A wind forecast is included through day 7. A detailed list of forecast elements included in the Fire Weather Planning Forecast and their definitions follows.

NWS offices use a Graphical Forecast Editor (GFE) to prepare a set of gridded forecasts of weather parameters out to 7 days (168 hours).
These elements include – maximum and minimum temperature; hourly temperature, dew point, relative humidity, wind speed and direction, and sky cover. Weather element,

probability of precipitation (POP), and precipitation amount (QPF) are generally forecast in six hour periods. Calculated elements include the Haines Index, mixing height, transport winds, and smoke dispersal.

Text products, including the Planning Forecast, are created by formatters from the GFE, which can then be hand edited by forecasters prior to transmission.

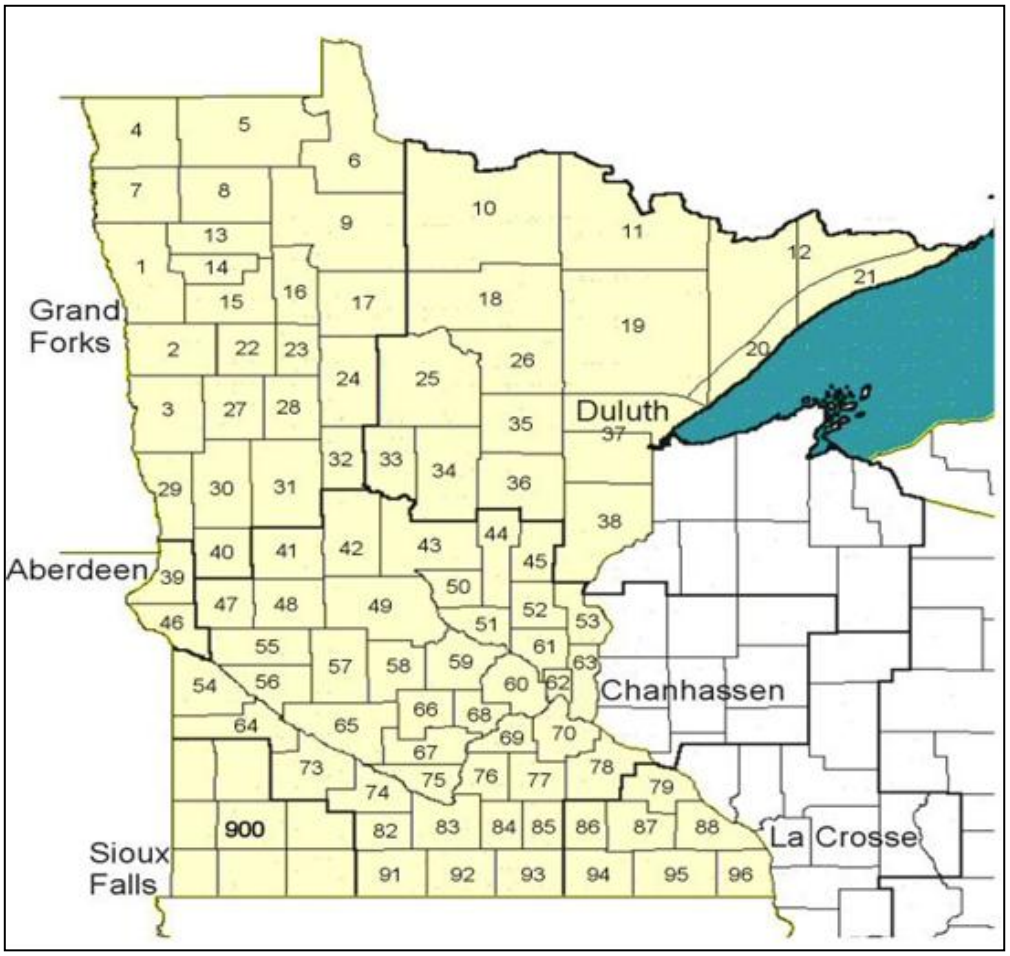

Figure 2. Forecast zone structure for NWS fire weather narrative products is shown below. Some zones are subdivisions of larger counties. Thick, black lines show the boundaries or the County Warning Areas (CWA) or each NWS office.

Forecast Elements in the Fire Weather Planning Forecast

Headline (Required for Red Flag Warnings and Fire Weather Watches)

- Highly encouraged to add headlines for other significant weather concerns or changes such as frontal passages - especially when little precipitation expected, very low humidity, gusty winds, etc.

Discussion

- written with enough detail to give users knowledge of weather causes during the forecast period. Emphasis on first 2 days and significant weather changes in later periods.
- provides frontal positions, movements and timing..
- serves as a vehicle to discuss reasoning for headlines or expected changes in critical parameters such as temperature, humidity, and wind

Sky/Weather

- sky and general weather conditions including trends
- as specific as possible on timing, duration and coverage of precipitation
- as specific as possible on cloud coverage, type, and trends

High and low temperature

- temperature ranges kept as small as possible. Fire Planning Forecast typically uses a 5 degree range.

Relative humidity

- forecast daytime minimum and nighttime maximum
- Fire Weather Planning Forecast typically uses a 5 degree range.

20 ft. wind speed (mph) and direction

- as specific as possible on timing of significant speed and directional changes
- given in ranges of 5 mph or less.
- gusts are also included
- forecast direction to nearest 8 cardinal compass points (northwest, north, southeast)

Other elements included:

Haines Index (mid level Haines used in Minnesota)

- determined for the 850 - 700 MB level (about 5,000 ft to 10,000 ft.)
- attached to "TODAY" and "NEXT DAY" on the morning narrative
- attached to the "TOMORROW" period on the afternoon forecast
- provided throughout the fire season when narrative forecast available.

Smoke Management parameters (See Appendix C for further explanation of terms)

- **Mixing Height** (feet) - The average mixing height from 1200 to 1800 hours local time.
- Included on the "TODAY" and "NEXT DAY" period of the morning forecast
- Included on the "TOMORROW" period on the afternoon forecast
- **Transport Winds (**speed (mph) and wind direction) in the mixed layer
- **Smoke Dispersal** - a number and a text ranking of poor, fair, good, or excellent
- provided throughout the fire season whenever narrative forecast available.

Hours of sunshine

- important for assessing probability of ignition of fine fuels (strong insolation can make fuels more likely to ignite)

Precipitation amount

- average areal amount.

Extended forecasts

- added after each forecast group providing forecasts for the 3-7 day period.
- included are: sky/weather, temperature, with a wind forecast thru Day 7.

**Optional elements in narrative forecasts may vary slightly between NWS offices

Figure 3. Example of a morning narrative forecast for part of central Minnesota

FIRE WEATHER PLANNING FORECAST FOR CENTRAL AND MOST OFSOUTHERN MN AND WC WISCONSIN
NATIONAL WEATHER SERVICE CHANHASSEN/TWIN CITIES MN
600 AM CDT WED MAY 6 2012

.DISCUSSION...AT DAYBREAK A COLD FRONT WAS MOVING INTO THE WESTERN DAKOTAS. WARMER AIR WILL PUSH INTO MINNESOTA AND WISCONSIN AHEAD OF THE FRONT. EXPECT SOUTHERLY SURFACE WINDS TO INCREASE AS THE FRONT APPROACHES. THESE WINDS WILL IMPORT MORE HUMID AIR INTO THE REGION. BY SUNSET THE FRONT WILL PUSH ACROSS THE WESTERN BORDER OF MINNESOTA ARRIVING IN EASTERN MINNESOTA EARLY THURSDAY MORNING. SCATTERED SHOWERS AND THUNDERSTORMS WILL ACCOMPANY THE FRONT. HIGH PRESSURE WILL THEN BUILD INTO THE AREA FOR THE NEXT SEVERAL DAYS BRINGING COOLER AND DRIER WEATHER.

MN039-041-046>048-054>056-064-062130-
TRAVERSE-DOUGLAS-BIG STONE-STEVENS-POPE-SWIFT-LAC QUI PARLE-CHIPPEWA-YELLOW MEDICINE-
INCLUDING THE CITIES OF ALEXANDRIA...MONTEVIDEO
600 AM CDT WED MAY 6 2012

.TODAY...
SKY/WEATHER.....SUNNY AND WARM.
MAX TEMPERATURE.....80 TO 85.
MIN HUMIDITY.....35 TO 40 PERCENT.
20-FOOT WINDS.....SOUTHWEST 10 MPH INCREASING TO 15 MPH BY NOON.
HAINES INDEX.....4 OR LOW.
HOURS OF SUN.....7 TO 9 HOURS.
PRECIPITATION.....NONE.
MIXING HEIGHT.....AROUND 5000 FT AGL (AVE 12-6 PM).
TRANSPORT WINDS.....SOUTHWEST 10 MPH (AVE 12-6 PM).
SMOKE DISPERSAL.....AROUND 50000 OR GOOD (AVE 12-6 PM).

.TONIGHT...
SKY/WEATHER.....MOSTLY CLOUDY. A 40 PERCENT CHANCE OF EVENING THUNDERSTORMS.
MIN TEMPERATURE…...55 TO 60.
MAX HUMIDITY.....85 TO 95 PERCENT.
20-FOOT WINDS.....SOUTHWEST 10 TO 15 MPH BECOMING WEST AFTER MIDNIGHT.
PRECIPITATION.....SCATTERED 0.10 to 0.20 INCH AMOUNTS.

.THURSDAY...
SKY/WEATHER.....PARTLY CLOUDY...BREEZY AND COOLER. A BRIEF AFTERNOON SHOWER
POSSIBLE. PRECIPITATION CHANCE IS 20 PERCENT.
MAX TEMPERATURE....73 TO 77.
MIN HUMIDITY.....35 TO 40 PERCENT.
20-FOOT WINDS.....NORTHWEST 10 TO 15 MPH INCREASING LATE MORNING TO 15 TO 20 MPH.
HAINES INDEX.....4 OR LOW.
HOURS OF SUN.....7 TO 9 HOURS.
PRECIPITATION.....ISOLATED 0.02 TO 0.05 INCH AMOUNTS.
MIXING HEIGHT..... AROUND 4000 FT AGL (AVE 12-6 PM).
TRANSPORT WINDS…...SOUTHWEST 20 MPH (AVE 12-6 PM).
SMOKE DISPERSAL…...AROUND 80000 OR EXCELLENT (AVE 12- PM).

.FORECAST DAYS 3 THROUGH 7....
.THURSDAY NIGHT…PARTLY CLOUDY. LOWS IN THE UPPER 40S. WIND NORTHWEST 10 MPH.
.FRIDAY…PARTLY CLOUDY. HIGHS IN THE LOWER 70S. WIND NORTHWEST 10 TO 15 MPH.
.FRIDAY NIGHT…PARTLY CLOUDY. LOWS IN THE LOWER 50S. WIND WEST 5 TO 10 MPH.
.SATURDAY…MOSTLY SUNNY. HIGHS IN THE MID 70S. WIND WEST 15 MPH.
.SATURDAY NIGHT…MOSTLY CLEAR. LOWS IN THE LOWER 50S. WIND SOUTHWEST 5 TO 10 MPH.
.SUNDAY.....PARTLY CLOUDY. WARMER. HIGHS IN THE UPPER 70S. SOUTHWEST WINDS 15 MPH.
.SUNDAY NIGHT…A CHANCE OF SHOWERS. LOWS IN THE UPPER 50S. WIND SOUTHWEST 10 MPH. CHANCE OF RAIN 30 PERCENT.
.MONDAY…A CHANCE OF THUNDERSTORMS. HIGHS AROUND 80. WIND SOUTHWEST 15 TO 20 MPH. CHANCE OF RAIN 40 PERCENT.
.MONDAY NIGHT…PARTLY CLOUDY. COOLER. LOWS IN THE LOWER 50S. WIND NORTHWEST 10 MPH.
.TUESDAY...PARTLY CLOUDY. HIGHS IN THE LOWER 70S. WIND NORTHWEST 15 TO 20 MPH.
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OTHER ZONE GROUPINGS TO FOLLOW

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Figure 4. Example of an afternoon narrative forecast, for a portion of northwest Minnesota.

FIRE WEATHER PLANNING FORECAST FOR E NORTH DAKOTA AND NW AND WC MINNESOTA
NATIONAL WEATHER SERVICE EASTERN NORTH DAKOTA/GRAND FORKS ND
300 PM CDT SAT JUN 6 2012

.DISCUSSION...GUSTY NORTHWEST WINDS AND COOLER TEMPERATURES WILL FOLLOW A COLD FRONT WHICH MOVED OUT OF THE AREA EARLIER TODAY. HIGH PRESSURE WILL PUSH INTO WESTERN MINNESOTA LATE SUNDAY BRINGING LESS WIND BUT CONTINUED COOL TEMPERATURES. A WARMING TREND WILL BEGIN ON TUESDAY AHEAD OF AN APPROACHING TROUGH OF LOW PRESSURE. THE APPROACH OF THE TROUGH WILL BRING A CHANCE OF SHOWERS BY THURSDAY NIGHT.

MN001>009-013>016-071200-
W POLK-NORMAN-CLAY-KITSON-ROSEAU-LAKE OF THE WOODS-W MARSHALL-E MARSHALL-N
BELTRAMI-PENNINGTON-RED LAKE-E POLK-N CLEARWATER-
INCLUDING THE CITIES OF ROSEAU...THIEF RIVER FALLS
300 PM CDT SAT JUN 6 2012

.TONIGHT...
SKY/WEATHER.....PARTLY CLOUDY AND COOL. BREEZY.
MIN TEMPERATURE.....45 TO 50.
MAX HUMIDITY.....90 TO 95 PERCENT.
20-FOOT WIND.....NORTHWEST 15 TO 20 MPH DIMINISHING TO 10 TO 15 MPH AFTER SUNSET.
PRECIPITATION.....NONE.

.SUNDAY...
SKY/WEATHER.....PARTLY CLOUDY...WINDY AND COOLER.
MAX TEMPERATURE.....60 TO 65.
MIN HUMIDITY.....35 TO 40 PERCENT.
20-FOOT WIND.....NORTHWEST 20 TO 25 MPH DECREASING TO 10 TO 15 MPH TOWARD SUNSET.
HAINES INDEX.....4 OR LOW.
HOURS OF SUN.....7 TO 9 HOURS.
PRECIPITATION.....NONE.
MIXING HEIGHT..... AROUND 4000 FT AGL (AVE 12-6 PM).
TRANSPORT WINDS.....NORTHWEST 25 MPH (AVE 12-6 PM).
SMOKE DISPERSAL.....AROUND 100000 OR EXCELLENT (AVE 12-6 PM).

.SUNDAY NIGHT...
SKY/WEATHER.....PARTLY CLOUDY.
MIN TEMPERATURE.....40 TO 45.
MAXIMUM HUMIDITY....90 TO 95 PERCENT.
20-FOOT WIND.....NORTHWEST 10 TO 15 MPH.
PRECIPITATION.....NONE.

.MONDAY...
SKY/WEATHER.....SUNNY.
MAX TEMPERATURE.....62 TO 66.
MIN HUMIDITY.....35 TO 40 PERCENT.
20-FOOT WIND.....NORTHWEST 10 TO 15 MPH.
HAINES INDEX.....4 OR LOW.
HOURS OF SUN.....7 TO 9 HOURS.
PRECIPITATION.....NONE.
MIXING HEIGHT.....AROUND 5000 FT AGL (AVE NOON-6 PM).
TRANSPORT WINDS.....SOUTHWEST 10 MPH. (AVE NOON-6 PM).
SMOKE DISPERSAL.....AROUND 50000 …GOOD (AVE NOON-6 PM).

.FORECAST DAYS 3 THROUGH 7....
.MONDAY NIGHT…MOSTLY CLEAR. LOWS IN THE LOWER 50S. WIND NORTHWEST 5 TO 10 MPH.
.TUESDAY…SUNNY. HIGHS AROUND 70. WIND NORTHWEST 10 TO 15 MPH.
.TUESDAY NIGHT….CLEAR. LOWS IN THE LOWER 50S. WIND WEST 5 MPH.
.WEDNESDAY…SUNNY. HIGHS IN THE LOWER 70S. WIND SOUTHWEST 10 MPH.
.WEDNESDAY NIGHT…PARTLY CLOUDY. LOWS IN THE MID 50S. WIND SOUTHWEST 10 MPH.
.THURSDAY…PARTLY CLOUDY. HIGHS IN THE MID 70S. WIND SOUTHWEST 10 TO 15 MPH.
.THURSDAY NIGHT… CHANCE OF SHOWERS. LOWS MID 50S. WIND SOUTHWEST 10 MPH. CHANCE OF RAIN 30 PERCENT.
.FRIDAY…A CHANCE OF THUNDERSTORMS. HIGHS IN THE MID 70S. WIND SOUTHWEST 15 TO 20 MPH. CHANCE OF RAIN 40 PERCENT.
.FRIDAY NIGHT…A CHANCE OF THUNDERSTORMS. LOWS IN THE MID 50S. WIND SOUTHWEST 10 MPH. CHANCE OF RAIN 40 PERCENT.
.SATURDAY...A CHANCE OF SHOWERS. HIGHS IN THE LOWER 70S. WIND WEST 10 TO 15 MPH. CHANCE OF RAIN 30 PERCENT.
$$
OTHER ZONE GROUPINGS TO FOLLOW

3. NFDRS POINT FORECAST (FWM)

Issued by 1530 local time for the following RAWS stations.

Chanhassen WFO		Duluth WFO		Grand Forks WFO		Aberdeen WFO		Sioux Falls WFO	
Sherburne	214001	Brainerd	212601	Baudette	210301	Big Stone	231501	Pipestone	216901
Litchfield	214501	Cass Lake	211604	Detroit Lakes	212201				
MN Valley	215601	Ely	210509	Roseau	210203				
Carlos Avery	214201	Hibbing	210512	Agassiz	210801				
Mora	213301	Moose Lake	211803						
Little Falls	213102	Rice Lake	211703						
		Saint Croix	213403						
		Seagull	210709						

The National Fire Danger Rating System (NFDRS) is designed to represent the fire potential at the "worst time of day" over a large area, generally in excess of 100,000 acres. The output from the NFDRS serves to indicate levels of fire danger. From this, resource allocation and staffing are determined by the land management agencies.

The NWS GFE formatters are used to generate the NFDRS point forecast from the gridded data base. Forecasters can edit these generated forecasts prior to issuing.

Each afternoon, by 1530 local time, the forecaster will issue point forecasts for stations at which reliable and timely observations are available on that day. If observations are not in the AWIPS collective, they can also be obtained from Internet sites such as the Real-time Observation Monitor and Analysis Network (ROMAN) collective.

If a known maintenance or data accuracy problem exists with an NFDRS forecast site, the problem will typically be reported to the station owner by the National Interagency Fire Center (NIFC) RAWS depot via e-mail. It is the duty of the station owner to take corrective action. If a NWS office knows of this problem and maintenance is not completed on the observation site, the NWS office may suspend the NFDRS forecast for that site until the problem is solved. Coordination and notification of the NFDRS forecast suspension will be coordinated with the Predictive Services section (Steve Marien) in the Eastern Area Geographic Area Coordination Center.

In 2011, the Fire Agencies implemented a combined automated and manual observation issuance system, using what is known as the Nelson model. This results in a new observation type "N" and indicates that the Nelson model was used in determining 1-hour and 10-hour fuel moisture. Though several Nelson model observations are generated, only the final "N" type observation is stored for the 1300 LST observation. Several N-model calculations are performed to generate automated State of Weather (SOW) and Wet Flag. A user can at this point manually edit the SOW and Wet Flag values based on local knowledge. In this case, the observation is recalculated, and the type of observation becomes "O" to indicate user editing. The manual editing of SOW and Wet Flag is the key difference, along with automatic availability of the "N" observation type.

During April and May, when necessary, and as forecast duties allow, the forecaster should update the NFDRS point forecasts issued from the previous afternoon if significant changes have occurred. These updates will be available by 0700. NFDRS forecasts will continue from spring through fall for all forecast points.

Lightning Activity Level (LAL) is not forecast for any Minnesota NFDRS sites.

NWS offices are encouraged to verify NFDRS forecasts and share results with State and Federal users.

Figure 5. Point Forecast coding and interpretation

The format is: (commas but NO spaces)

FCST,SSCCNN,YYMMDD,VT,W,TT,RH,L1,L2,DD,VV,M,TM,TN,HM,HN,P1,P2,WF

STN # code SSCCNN where SS = State (21 is MN) CC = County NN = station

SSCCNN - 6 digit station number from above
YYMMDD - valid day of fcst - year/month/day. The forecast made on April 10, 2010 for the 11th would be 100411
VT - Valid time. always a 13 for 1300 CST (2pm CDT)
W - State of the weather at 1300 CST tomorrow as shown below

0	= less than 1/8 clouds	4 = fog	7 = snow/sleet
1	= 1/8 to 4/8 opaque clouds	5 = drizzle	8 = showers
2	= 5/8 to 7/8 opaque clouds	6 = rain	9 = thunderstorms
3	= cloudy	(*Note: categories 5, 6, or 7 set NFDRS indecies to zero*)	

TT = temperature for 1300 CST tomorrow
RH = relative humidity for 1300 CST tomorrow
* L1 = lightning activity level (1400 CST today until 2300 CST). Always a "1" in Minnesota
* L2 = lightning activity level (2300 CST today until 2300 CST tomorrow). Always a "1" in Minnesota
DD = wind direction at 1300 CST tomorrow (8 point compass)
VV = 20 ft wind speed in mph at 1300 CST tomorrow
M = 10 hr fuel moisture (input by the users and left blank by the forecaster). Two commas will be noted next to each other
TM = maximum temperature from ***1300 CST to 1300 CST***
TN = minimum temperature from 1300 CST to 1300 CST
HM = maximum humidity in percent from 1300 CST to 1300 CST
HN = minimum humidity in percent from ***1300 CST to 1300 CST***
P1 = pcpn duration in hours from 1300 CST today till 0500 CST tomorrow
P2 = pcpn duration in hours from 0500 CST tomorrow till 1300 CST tomorrow
WF = Wet Flag. A Y or N. It is used to indicate if fuels will be wet at 1300 CST. All indices will be forced to zero if a Y used. If fuels covered with snow, set to Y.

* The L1 and L2 values can range from 1 to 6. The higher the number, the greater the risk of lightning. LALs correspond roughly to categories of thunderstorm density:
1 = none, 2 = isolated, 3 = few, 4 = scattered, 5 = numerous. An LAL of 6 is generally reserved for the west where dry lightning is a problem.
At the request of user agencies in Minnesota, the *LAL forecast will always be set to 1 (none).*

4. SPOT FORECASTS

Spot Forecasts are **site specific forecasts** issued by NWS offices in support of wildfire management, and natural resource management. These forecasts aid land management and fire control agencies in protecting life and property during wildland fires, hazardous fuels reduction, and rehabilitation and restoration of natural resources. Spot forecasts are also issued for hazardous materials incidents, marine incidents, search and rescue response and other threats to public safety. Generally, Spot Forecasts for prescribed burns are requested a few hours ahead of the project. They can, however, be requested up to one day in advance. Alternative planning tools and forecasts should be used for projects that will not be started within one day of the request. Planned, advance spot forecasts up to one day in advance can however be coordinated with the servicing NWS office for active, long-duration emergencies or fires.

Spot forecasts for a wildfire will be treated with a priority similar to that of severe weather warnings. It is the responsibility of the requestor to indicate that the request is for wildfire suppression. The NWS will attempt to process all Spot Forecast requests within 40 minutes.

Some planning tools available for long range planning include:

1) The Fire Weather Planning Forecast from NWS offices.

2) Graphical Weather Forecast available at http://graphical.weather.gov/

3) 7-Day Forecast/Hourly Weather Graph/Digital and Tabular Data available at http://forecast.weather.gov/gridpoint.php?site=xxx where xxx is the local office
(mpx = Twin Cities, dlh = Duluth, fgf = Grand Forks, abr = Aberdeen, fsd = Sioux Falls, arx = La Crosse.)

4) Weather Activity Planner available at: http://forecast.weather.gov/wxplanner.php?site=xxx

In accordance with NWS Directive NWSI-401:
NWS offices will provide spot forecasts upon request of any federal, state, tribal, or local official who represents the spot forecast is required to support a wildfire.

For non-wildfire purposes, resources permitting, NWS offices will provide spot forecast service under the following circumstances and conditions:

a. Upon request of any federal official who represents that the spot forecast is required under the terms of the Interagency Agreement for Meteorological Services.
b. Upon request of any state, tribal, or local official who represents that the spot forecast is required to carry out their wildland fire management responsibilities in coordination with any federal land management agency participating in the Interagency Agreement.
c. Upon request of any public safety official who represents the spot forecast is essential to public safety, e.g.due to the proximity of population centers or critical infrastructure. A "public safety official" is an employee or contract agent of a government agency at any level (federal, state, local, tribal, etc) charged with protecting the public from hazards including wildland fires of whatever origin and/or other hazards influenced by weather conditions such as hazardous material releases.
d. In support of Homeland Security Presidential Directive #5. (HSPD 5).
   http://training.fema.gov/EMIWeb/IS/ICSResource/assets/HSPD-5.pdf
   NWS offices **will not** provide spot forecasts to private citizens or commercial entities not acting as an agent of a government agency.

Requestor Identification - The requestor for each spot forecast must provide the following information before a spot forecast can be issued. All spot forecasts posted to the Internet will be available for public viewing.

a. Name
b. Government agency
c. Address and phone number
d. Representation as to the reason for the spot forecast, which must be one of the reasons indicated above.

A current on-site weather observation should accompany the forecast request. The requestor should specify how the wind measurement was obtained (20 foot or eye-level). In the case of a wildfire or prolonged prescribed burn, updated observations should be provided during the course of the event. It is suggested that requestors use the REMARKS section of the Spot Forecast request to indicate critical weather parameters such as wind direction or shifts that would be problematic for the operation.

To aid in making smoke management decisions, requestors may now request Hysplit trajectory data as part of their Spot Forecast request.

Land management personnel should contact the servicing NWS office for an update if forecast conditions appear unrepresentative of actual weather conditions. Spot forecasts should be considered one-time requests, and are not routinely monitored, nor updated. Spot forecasts may be updated when representative observations are available to the forecaster, he/she deems the current forecast does not adequately represent current or expected weather conditions, and emergency contact information is available to disseminate the update. If an update is made, the forecaster must call the emergency contact number listed on the spot forecast request. Feedback from land management personnel is also encouraged during or after the burn.

Users are asked to read the most recent Fire Weather Planning Forecast before making a spot forecast request.

A. **SPOT Content and Format –**
The standard format for wildfire spots includes: headlines (mandatory when Red Flag Warning or Fire Weather Watch in effect), discussion, sky/weather, temperature, relative humidity, and 20 foot wind for 3 forecast periods. Optional elements may also be provided. See example below. The content of non-wildfire spots should conform to the standard format for wildfire spots, though the content and number of forecast periods may be different, as determined by the requestor.

B. **Requesting a SPOT Procedure –**

a. An Internet-based program, NWS Spot, is the national standard for requesting, issuing, and retrieving spot forecasters. This program is available on NWS web sites. See *Appendix H* for detailed information on using the Spot Request Page. Spot forecasts can also be requested by phone or fax if NWS Spot is inoperative or if discussion is needed with a forecaster. In these cases, a phone call must accompany a fax request so the forecaster is aware of the request.

b. The requesting agency should provide information about the location, topography, fuel type(s), size, ignition time, and a contact and telephone number of the responsible land management official. A representative weather observation should accompany the request. Justification for the spot forecast request must also be provided for the request to

be honored. Feedback to the NWS office providing the spot forecast is highly encouraged.

c. Spot Forecasts can be viewed in a KML file in Google Earth from the NWS Fire Weather Page at http://radar.srh.noaa.gov/fire/

Figure 6. Example of a Standardized Spot Weather Forecast for a wildfire

SPOT FORECAST FOR CRAZY LAKE FIRE
ISSUED BY NATIONAL WEATHER SERVICE DULUTH, MN
11 AM CDT MONDAY MAY 10 2012

IF CONDITIONS BECOME UNREPRESENTATIVE CONTACT THE NWS

...INCREASING WINDS THIS AFTERNOON... *(headline required for Red Flag Warnings and Fire Weather Watches and recommended for every issuance.)*

.DISCUSSION...SOUTHWEST WINDS WILL INCREASE AHEAD OF AN APPROACHING COLD FRONT. THE FRONT WILL REACH THE BURN AREA BETWEEN 4 PM AND 6 PM THIS EVENING. WINDS WILL RAPIDLY BECOME NORTHWEST AND REMAIN GUSTY UNTIL DARK. AN ISOLATED THUNDERSTORM MAY FORM NEAR THE COLD FRONT.

.REST OF TODAY...
SKY/WEATHER.....MOSTLY SUNNY AND DRY. GUSTY WINDS. AN ISOLATED
THUNDERSTORM POSSIBLE BETWEEN 4 AND 7 PM.
TEMPERATURE.....82 TO 86
HUMIDITY.....32 TO 36 PERCENT
20-FOOT WIND.....SOUTHWEST 15 TO 20 MPH WITH GUSTS TO 25 MPH. WINDS
BECOMING NORTHWEST AFTER 4 PM AND REMAINING GUSTY.
HAINES INDEX.....5 OR MODERATE

.TONIGHT...
SKY/WEATHER..... MOSTLY CLEAR WITH DECEASING WINDS
MIN TEMPERATURE....55 TO 60
MAX HUMIDITY.....80 TO 85 PERCENT
20-FOOT WIND.....NORTHWEST 10 TO 15 MPH DECREASING 5 TO 8 MPH BY 10 PM.

.TUESDAY...
SKY/WEATHER.....PARTLY CLOUDY. BECOMING BREZZY AGAIN.
HIGH TEMPERATURE....77 TO 81
MIN HUMIDITY.....34 TO 38 PERCENT
20-FOOT WIND.....NORTHWEST 8 TO 12 MPH INCREASING TO 15 TO 20 MPH AFTER 11 AM.
$$
(Optional elements may be added at request of user)

Figure 6. Example of a Standardized Spot Weather Forecast for a wildfire.

5. FIRE WEATHER WATCHES AND RED FLAG WARNINGS

NWS offices will issue Fire Weather Watches and Red Flag Warnings when the combination of dry fuels and weather conditions support extreme fire danger and/or fire behavior. Primary user agencies (USFS and MN DNR) are responsible for keeping the NWS aware of fuel conditions which could lead to extreme fire danger. The NWS will coordinate with user agencies prior to issuing Fire Weather Watches and Red Flag Warnings. However, if a Fire Weather Watch is currently in effect, it means that weather and fuels conditions have already been coordinated with land managers. In this case, no further coordination is required, if a Red Flag Warning is subsequently issued for the same time period and area. *See call list under 4.c. - Procedures.* Any National Forests affected will be specified in the Watch or Warning. During situations of borderline criteria for a Fire Weather Watch or Red Flag Warnings terminology such as SEVERE FIRE WEATHER CONDITIONS MAY OCCUR MONDAY AFTERNOON is strongly encouraged in the synopsis portion of the routine

narrative forecast. A Fire Weather Watch/Red Flag Warning checklist is shown in Figure 8.

A **Fire Weather Watch** is issued when there is a reasonable level of confidence that **BOTH** of the weather conditions listed below are expected to be met within 18 to 72 hours, after consultation with appropriate land managers concerning fuel conditions. A Fire Weather Watch cannot be issued for the first forecast period. If a Watch is in effect for the TODAY period, the midnight shift forecaster must either upgrade to a Red Flag Warning or cancel the Watch.

A **Red Flag Warning** denotes a high degree of confidence weather and fuel conditions consistent with Red Flag Event criteria will occur within 48 hours. A Red Flag Warning is issued immediately, after consultation with land managers, if both of these conditions are observed or imminent.

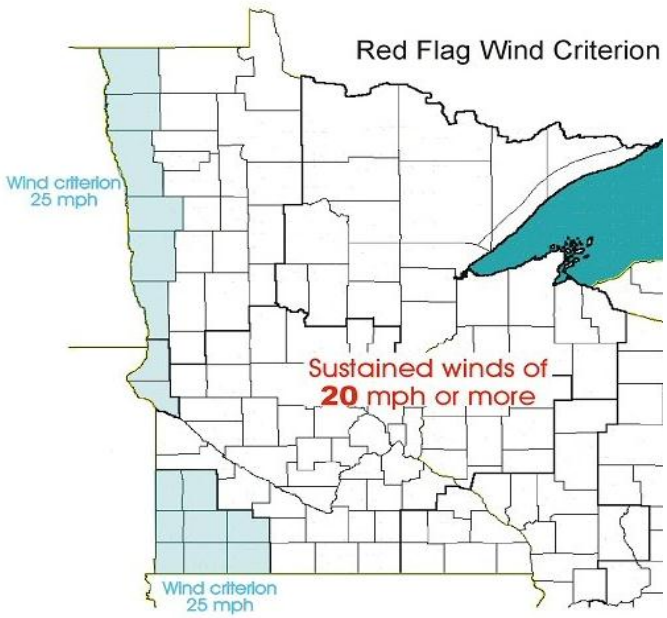
Land managers could request that a Red Flag Warning be issued with weather criteria not meeting these values, if fuels are critically dry – for example, a high wind situation when the humidity threshold may not be reached.

RED FLAG WARNING / FIRE WEATHER WATCH CRITERIA

1. Sustained one-minute winds at standard 20 foot level are at or above 20 mph. *However, in the Red River Valley along the western border of Minnesota and in the southwest corner of the state sustained winds must be at or above 25 mph. See the map depicting these areas in Figure 7.*

2. Minimum relative humidity at or less than 25 percent.

Note: Operationally, the wind used in Red Flag decisions is usually a 33 foot ASOS/AWOS wind. A dense network of airport observing sites across Minnesota provides wind reports at least hourly for the forecaster to use in making watch or warning decisions. Research has shown that the reduction from a 33 foot wind to a 20 foot wind is 10% or less for comparably sited instruments.



Other factors to consider in Watch/Warning decisions;

- Fire Danger Index in the high to extreme category. Source maps for the Fire Danger Rating are on the Minnesota DNR web page at http://www.dnr.state.mn.us/forestry/fire/
- NFDRS output from the NWS product NMCFDICR product which provides information on the Burning Index (BI) and Energy Release Component (ERC). Generally, the BI should be above 4, and the ERC over 40 when a Watch or Warning is issued.

When Red Flag conditions have ended or are no longer expected, the Watch or Warning will be cancelled. This will be coordinated with MIFC.

Content/Format

The Watch or Warning headline will specify:

- The valid time, type of event, area affected, and critical weather elements causing the warning to be issued.
- The following list of products will disseminate the Watch or Warning:

  A Fire Weather Message (RFW) will carry the Watch or Warning Headline. Following the headline will be a discussion of the weather feature(s) causing the event and detail as to the reasons for the event***. (Note: the example below does not include the weather discussion).*** The RFW will employ a **BULLET FORMAT**, as shown below, for each segment of the Watch/Warning.

```
...FIRE WEATHER WATCH REMAINS IN EFFECT FRIDAY AFTERNOON FOR STRONG
WINDS AND LOW HUMIDITY LEVELS FOR CENTRAL AND MOST SOUTHERN
MINNESOTA...

A FIRE WEATHER WATCH REMAINS IN EFFECT FRIDAY AFTERNOON.

* AFFECTED AREA...CENTRAL AND MOST OF SOUTHERN MINNESOTA.

* WINDS...SOUTH 15 TO 25 MPH WITH GUSTS UP TO 35 MPH.

* RELATIVE HUMIDITY...AS LOW AS 20 PERCENT.

* TEMPERATURE...80 to 85.

* IMPACTS...FIRES COULD BECOME DANGEROUS AND FAST MOVING IN A
  SHORT PERIOD OF TIME DUE TO THE GUSTY WINDS AND LOW HUMIDITY
  LEVELS.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

A FIRE WEATHER WATCH MEANS THAT CRITICAL FIRE WEATHER CONDITIONS
```

- The **Fire Weather Planning Forecast (FWF)** will include the headline with the DISCUSSION The headline will also be carried in the appropriate zone groupings. The FWF will be updated if a Watch or Warning is issued at a non-scheduled forecast issuance time.
- The USFS and/or DNR may wish the NWS to distribute a **public statement (RFD)** to be distributed to the media. User agencies will provide guidance as to statement content and if they wish the Red Flag terminology to be used in the product.
- Following local policy a NWS office may broadcast a Red Flag Warning or Fire Weather Watch on **NOAA Weather Radio**.
- Watches or Warnings should also be included in the **Hazardous Weather Outlook (HWO), Graphical Forecasts** and **Area Forecast Discussion (AFD).**
- Any **Spot Forecasts** issued for areas in which the Watch/Warning is in effect will include the appropriate headline.
- User agencies will normally handle all public and media questions about fire potential and danger. The NWS will answer questions only about weather conditions, but should not comment on fire conditions.

Figure 8 – Fire Weather Watch / Red Flag Warning Checklist

FIRE WEATHER WATCH AND RED FLAG WARNING ACTION CHECKLIST (this list may be modified by NWS offices whose fire weather responsibility extends into adjacent states)

Issued		**Canceled**
Date_____	Fire Weather Watch ____	Date_____
Time_____	Red Flag Warning _____	Time_____
Forecaster_____		Forecaster_____

COORDINATION

WFO Minneapolis Time _____
WFO Grand Forks Time _____
WFO Green Bay Time_____
WFO Duluth Time_____
WFO La Crosse Time_____
WFO Sioux Falls Time_____
WFO Aberdeen Time _____

Make these CALLS prior to issuing the Watch or Warning

1) Minnesota DNR, at MIFC Doug Miedtke 218-327-4445
   Time_____

2) **Minnesota Interagency Fire Center (MIFC)**
   MIFC Dispatch (24 hours) 218-327-4558 FAX 218-327-4528 Time_____

(note: if coordination is completed with one of the above, they may be able to contact the other party for you). Try calling Doug Miedtke first.

If a National Forest is affected also call:
Gary Moberly, Forest Dispatcher 218-327-4176 Time_____

And, when time permits, call:
Eastern Area Interagency Coordination Center (EACC) in Milwaukee / Duty Officer (24 Hour operation)
414-944-3811 FAX 414-944-3838 Time_____
EACC Meteorologist Steve Marien 651-290-3030

DISSEMINATION

RWF Time_____
Added to regularly scheduled FWF: Time _____
Updated FWF: Yes_____ Time_____ No_____
Public statement (coordinated with user agency) Time_____
NWR dissemination (Local NWS policy) Time_____
Notes:_____
_____
_____

6. OTHER ROUTINE NWS SERVICES

- **Verification -** Fire weather program leaders will verify the Red Flag program. Results will be distributed to the NWS Regional Fire Weather Program Managers as well as to the appropriate State and Federal user groups in Minnesota. Red Flag Warnings will be verified based on the Probability of Detection, False Alarm Rate, Critical Success Index, and Lead Time.

- **Participation in Interagency Groups -** NWS offices providing fire weather services for Minnesota are expected to participate in the Annual State Fire Meeting. This meeting serves as a forum for interaction between NWS program leaders and their interagency users. It also provides an effective vehicle for discussions pertaining to changes to the AOP.

- **National Digital Forecast Database (NDFD) -** The NWS provides another forecast tool called the National Digital Forecast Database (NDFD). This database contains forecast weather parameters on a 2.5 or 5.0 kilometer grid. The NDFD runs through day 7, and is continually updated by NWS forecasters. Access to the NDFD is possible through NWS web pages by selecting the Forecast Graphics Tab near the top of the page. Information on the NDFD can be found at the following link: http://www.weather.gov/ndfd/

B) SPECIAL SERVICES –

1. INCIDENT METEOROLOGISTS

The NWS provides a cadre of trained Incident Meteorologists (IMETs) who will provide on-site forecasting for wildfires when requested by land management agencies. A certified IMET is on staff at the Minneapolis/Chanhassen NWS office. In addition to wildfires, IMETs may be dispatched to support:

- Large critical resource value prescribed burns. An example would be the Fuels Reduction Project in the Boundary Waters Area of Northeast Minnesota.
- Land management coordination and dispatch centers
- Hazardous substance release
- Any special projects or incidents which fall under the mandate of the NWS.

See NWS Directive 10-402 http://www.nws.noaa.gov/directives/sym/pd01004002curr.pdf

By Interagency Agreement, the NWS will support land management agency requests for on-site meteorological support for wildland fires through the IMET program. Other events listed above may be supported depending upon resource availability, if requested by federal fire agencies participating in the Interagency Agreement, or if requested by public safety officials who represent such support as essential to public safety.

Some Key Points:

- Only certified Type 1 IMETS may be dispatched to support on-site service for Fire. The NWS is responsible for maintaining proficiency of designated IMETs.
- The Type 1 IMET is responsible for maintaining his/her availability with the NWS Fire Weather Operations Chief Coordinator (NFWOC) at NWS Boise and in the Resource Ordering and Status System (ROSS)
- The IMET will arrive at the Incident with an All Hazard Meteorological Response System

(AMRS). The AMRS is used to provide a mobile platform for data collection and forecast preparation.

- The IMET or the Incident may request an Atmospheric Theodolite Meteorological Unit (ATMU) (NFES 1836) to obtain on-site upper level winds. Helium will also be ordered for the ATMU upon request.
- The NWS is responsible for assembly and operation of this equipment, calibration of instruments, ordering contract repair, and, if necessary, scheduling training sessions.
- IMET data needs will be obtained by one of three means:
  a) Incident provides communications through a LAN
  b) Verizon Wireless Jetpack Wifi
  c) As last resort, BGAN/INMARSAT (satellite comms) at an estimated cost of $1000 to $1500/day.
- The NWS is responsible for assembly and operation of this equipment, calibration of instruments, ordering contract repair, and, if necessary, scheduling training sessions.
- Request and dispatch of IMETs and equipment is accomplished through the National Resource Coordination System. The request will be sent to the Eastern Area Coordination Center (EACC). They will in turn forward the request to the NWS National Fire Weather Operations Coordinator (NFWOC) in Boise who will fill the order.
- Incident Operations - The IMET must be provided a work area free from rain and wind as well as telephone access, if no cell phone coverage is available. The line is typically shared with the Fire Behavior Analyst (FBAN). A source of power is also necessary (generator is OK). The IMET will work the hours and perform the forecast tasks required by the Incident Management Team. When a fire is declared contained or controlled, the IMET will assess the time requirement for further support in conjunction with the FBAN and Plans Section Chief.
- Reimbursement for Services Provided - The NWS will be reimbursed for all costs associated with on-site operation as set forth in the Interagency National Agreement. This can be found in the "Admin" link on the National Fire Weather web page: http://www.weather.gov/fire Reimbursement includes all overtime costs associated with the deployment, travel costs and per diem, telecommunication services, as well as costs incurred by the NWS IMET duty station such as covering shifts vacated by the IMET.
- After each deployment, the IMET will prepare a Report of Reimbursable Expenses. The NWS will recover costs based on this report.
- Upon release from an Incident, NWS offices will follow the Memorandum of Understanding between the NWS and NWS Employees Organization regarding rest periods for IMETs following a deployment.

C. TRAINING -

1. Forecaster training - NWS forecasters producing fire weather forecasts require training as set forth in NWSI 10-405:
http://www.nws.noaa.gov/directives/sym/pd01004005curr.pdf

a. Complete any required NWS Fire Weather computer based learning modules and S-290, Intermediate Wildland Fire Behavior.
b. Local training generally consists of review of the AOP, the Fire Weather Station Duty Manual and other station instructions, as well as training offered by the Fire Weather Program Leader or land management personnel.
c. Forecasters must be familiar with NWS fire weather products and services and be proficient in their preparation and dissemination.
d. All forecasters issuing Spot Forecasts or providing phone briefings to first responders are required to complete IS-100 and IS-700

2. IMET Training and Certification requirements - are also detailed in NWSI 10-405. **http://www.nws.noaa.gov/directives/sym/pd01004005curr.pdf**

3. NWS provided training to land management agencies - when NWS staff provides training to land management personnel, costs above planned salary and operating costs may be borne by benefiting agency(s). See the following guidelines for NWS Instructors Teaching Interagency courses from Appendix A of NWSI 10-403. http://www.nws.noaa.gov/directives/sym/pd01004003curr.pdf

NWSI 10-403 APRIL 5, 2010 Appendix A –

Guidelines for Teaching Interagency Courses

1. The request for a NWS instructor for fire agency courses comes through the requesting agency. As with any other out-of-office training assignment, sufficient lead time of typically several months is needed for scheduling purposes and the request is coordinated through the local Weather Forecast Office's Meteorologist-In-Charge. If the office or Region supplying the NWS instructor expects or requires reimbursement, an Interagency Agreement is established with the land management unit paying for the training. For the United States Forest Service (USFS), this Agreement is usually established using the United States Department of Agriculture (USDA) form AD-672. For the Department of Interior, the requesting Agency supplies an Interagency Agreement (IAA) in the local unit's appropriate format. Once the requesting agency initiates and completes their official request form or IAA for training, it is the responsibility of the requested NWS instructor's Region to complete and establish coding for reimbursement. It is important to note that the Interagency National Agreement for Fire Weather Services does not provide the legal or financial exchange mechanism to execute training. More detailed instruction on training agreements, including sample templates, are available on the Incident Meteorologist (IMET) Reimbursable Expense Report (RER) instructions.

2. The course should have a local, state, or federal land management instructor paid by that agency to team teach with the NWS instructor. The co-instructor cannot be from a private vendor or academic institution.
    a. If 1 and 2 above are satisfied, then an instructor can be provided with all overtime and travel costs borne by the requesting agency once an AD-673 or IAA is completed. If 1 and 2 cannot be satisfied or it is unclear whether a local, state, or federal land management instructor has been provided, then go to number
3. The following questions are asked by the WFO to determine whether an NWS instructor can be approved for the course in question:
    a. Is the NWS instructor unique or can this course by taught by anyone else? Are other fire weather instructors (non-NWS) ready, willing and able to teach the course? Contact the Geographic Area Predictive Services meteorologist(s) for information concerning the availability of non-NWS fire weather instructors.
    b. If it is determined through coordination with the Geographic Area Predictive Services meteorologist(s) that non-NWS instructors are not ready, willing and able to teach the course, can the NWS be reimbursed for overtime and travel costs?
    c. If it is determined by answers to questions 3a and 3b that an NWS instructor is appropriate and can be reimbursed, then the NWS instructor may teach the course.

D. NWS EMERGENCY NOTIFICATION TO CENTRAL REGION HEADQUARTERS.

In the event of a major wild fire in MN, the servicing NWS office must report it to the MIC and NWS Central Region Headquarters. A major fire event is one which results in one or more fatalities, numerous injuries, major property damage, or significant media attention. CRH must

also be notified of an IMET deployment. To notify CRH, use procedures detailed in *CR Intranet (Emergency Reporting) – Weather/ Water Significant Event Information.*

III. WILDLAND FIRE AGENCY SERVICES AND RESPONSIBILITIES

A. OPERATIONAL SUPPORT AND PREDICTIVE SERVICES - The GACC Meteorologist for the Eastern Area Coordination Center (EACC) works in a St. Paul office, while the EACC office is now in Milwaukee. The GACC meteorologist combines forecast information from NWS offices and other sources into area-wide summaries and briefings. This meteorologist, along with Fire Intelligence, forms the Predictive Services group which produces fire weather/fire danger assessments for USFS Region 9 which includes Minnesota. These value added products enhance short and long range forecasts issued by the NWS to assist land managers in allocating fire-fighting resources. The EACC website - http://gacc.nifc.gov/eacc/

Mailing address:
Eastern Area Coordination Center
626 E. Wisconsin Avenue , Suite 500
Milwaukee, WI 53202
Phone 414-944-3811, Fax 414-944-3838
Center Manager, Laura McIntyre-Kelly
Deputy Center Manager, Matt Dillon

EACC Meteorologist
Steve Marien
Mississippi Natl River and Rec. Area
111 East Kellogg Blvd, Suite 105
St. Paul, MN 55101
Phone 651-290-3030
Fax 651-290-3815

B. AGENCY COMPUTER SYSTEMS - The communication system used to link the NWS with its users is the Weather Information and Management System (WIMS). The NWS receives user agency observations entered into WIMS via its Advanced Weather Interactive Processing System (AWIPS) computer system. Point and narrative forecasts are also sent to WIMS via this system. Observations and forecasts are exchanged between WIMS and AWIPS in the USFS Kansas City Computer Center.

C. FIRE WEATHER OBSERVATIONS - All fire weather observations in Minnesota are from automated sites, and all have GOES antennas installed for data transmission. Station inspection and instrument maintenance are the responsibility of land management agencies. NWS forecasters may monitor data quality from observation sites. See Figures 9 and 10.

If a land management agency request that NWS personnel assist in setting up a RAWS station, the NWS will oblige per the National Agreement. NWS travel expenses for equipment maintenance or station visits will be reimbursed by the Wild Land Fire Agency making the request. The NWS Regional Fire Weather Program Leader (RFWPL) and EACC Meteorologist need to be informed of any requests for new RAWS stations.

The NWS is responsible for assigning station numbers to NFDRS weather sites. The NWS local Fire Weather Program Leader will coordinate with the NWS RFWPL who will then work with appropriate land management personnel and WIMS staff to determine the 6-digit station ID. Once the station ID is coordinated/determined, the NWS RFWPL will provide it to the requestor and responsible NWS office.

It is the responsibility of the requestor/land management personnel to notify WIMS staff of RAWS station status.

Figure 9. Locations of fire weather observation points and automated airport observing systems. The names shaded with yellow receive point forecasts through the fire season.

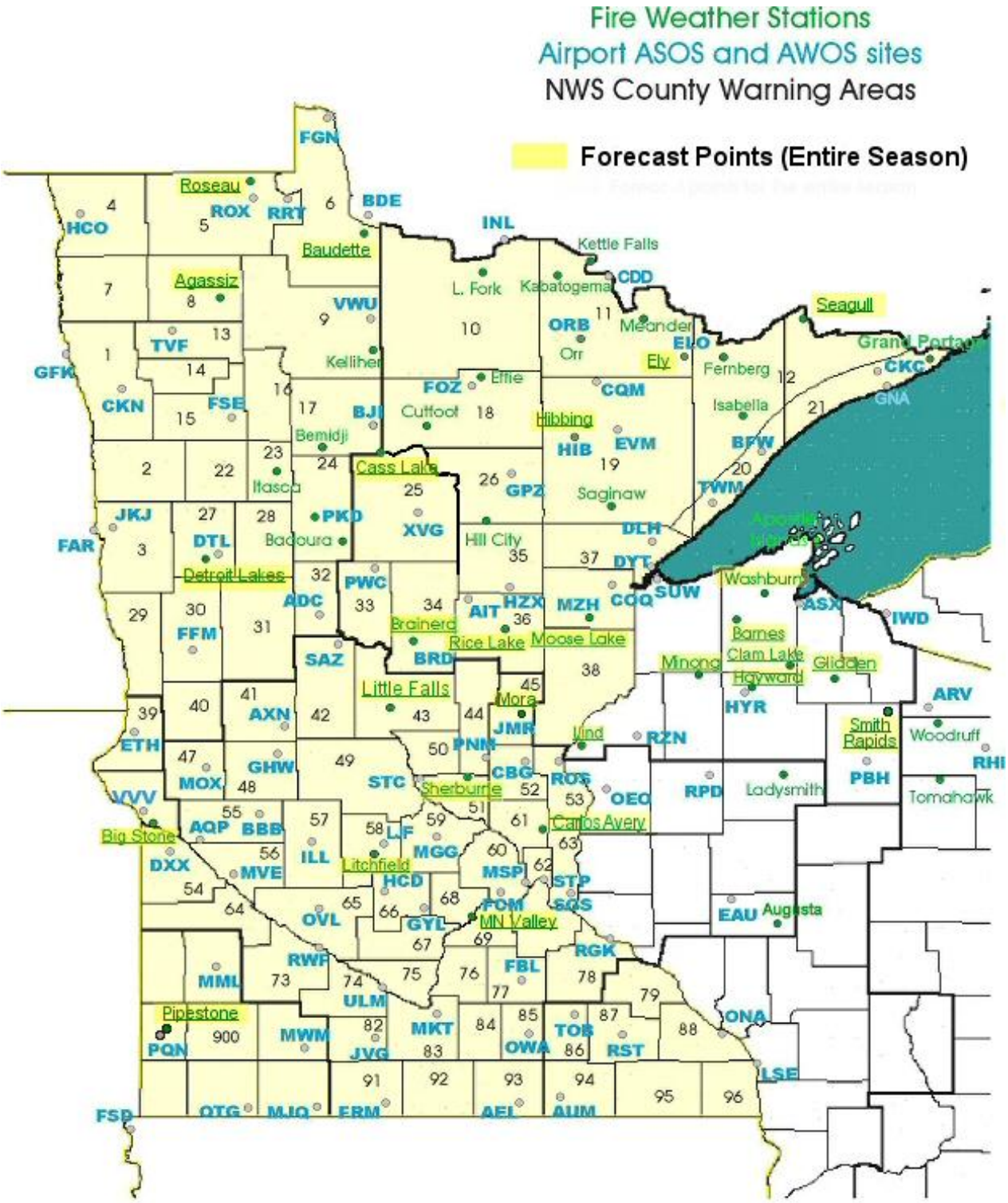
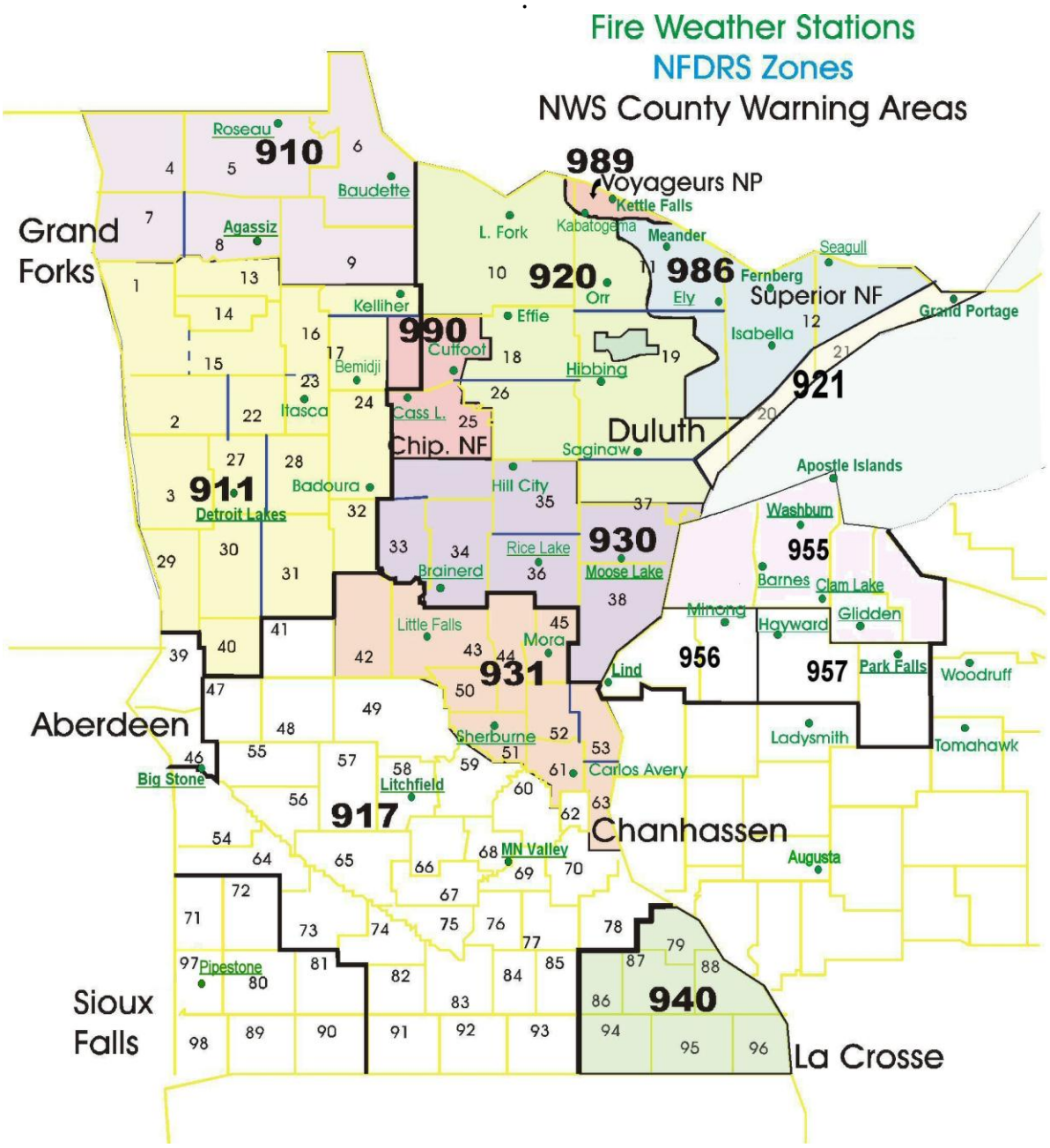


Figure 10 NFDRS zones and the agency observation points



Some Internet sites available to view fire weather observations include:

http://raws.wrh.noaa.gov/roman
http://www.wrcc.dri.edu/wraws/mnF.html
http://mesowest.utah.edu/index.html (this site contains a very useful interactive map)

Some other useful Internet Links include:

National Centers

http://radar.srh.noaa.gov/fire/: National Fire Weather Page
http://www.spc.noaa.gov/products/fire_wx: Storm Prediction Center, Norman, OK (National Fire Weather Guidance).
http://www.nifc.gov: US National Interagency Fire Center
http://www.fs.fed.us/eacc: Eastern Area Coordination Center

International Centers

http://www.ciffc.ca: Canadian Interagency Fire Center

Automated Fire Weather Stations in Minnesota

Minnesota DNR							**U.S. Forest Service**					
		Zone	Lat	Lon	Elev				Zone	Lat	Lon	Elev
Mora	210301	910	48.67	94.62	1083		Ely	210509	986	47.89	91.87	1470
Badoura	211502	911	46.86	94.73	1420		Fernberg	210607	986	47.95	91.49	1700
Bemidji	210901	911	47.5	94.93	1377		Meander	210503	986	48.12	92.02	1520
Brainerd	212601	930	46.4	94.13	1220		Cass Lake	211604	990	47.38	94.6	1320
Carlos Avery	214201	931	45.29	93.12	900		Cutfoot	211005	990	47.54	94.05	1330
Effie	211004	920	47.78	93.65	1340							
Hill City	211702	930	47.04	93.6	1340		**U.S. Fish and Wildlife Service**					
Sagianw	210511	920	46.84	92.46	1330				Zone	Lat	Lon	Elev
Roseau	210203	910	48.85	95.7	1047		MN Valley	215601	917	44.72	93.64	845
Hibbing	210512	920	47.39	92.83	1350		Litchfield	214501	917	45.7	94.53	1075
Orr	210514	920	48.02	92.86	1325		Rice Lake	211703	930	46.54	93.29	1185
Itasca	211401	911	47.24	95.19	1450		Sherburne	214001	931	45.53	93.75	1002
Kelliher	210902	911	47.94	95.46	1350		Big Stone	213501	917	45.26	96.34	878
Littlefork	210405	920	48.39	93.56	1158		Detroit Lakes	212201	911	46.85	95.85	1385
Moose Lake	211803	930	46.42	92.8	1070		Agassiz	210801	910	48.5	95.87	1174
Seagull	210709	986	48.12	90.84	1480							
Isabella	210602	986	47.63	91.41	1990		**National Park Service**					
St Croix	213403	930	45.97	92.62	920				Zone	Lat	Lon	Elev
Mora	213301	931	45.89	93.27	1012		Kabetogema	210507	989	48.44	93.05	1200
							Kettle Falls	210516	989	48.5	92.64	1160
Grand Portage Agency							Pipestone	216901	917	44.03	96.27	1660
Grand Portage	210703	921	47.95	89.78	1200		Little Falls	213102	931	45.95	94.34	1125

D. REIMBURSEMENT FOR NWS PROVIDED ON-SITE SUPPORT AND TRAINING -- Agencies will reimburse the NWS for all costs incurred for IMET support as well as for training assistance or station visitation.

For wildfires, procedures are detailed in the Interagency National Agreement found in the "Admin" link on the National Fire Weather web page: http://www.weather.gov/fire. For training, see NWSI 10-403 Appendix A at http://www.nws.noaa.gov/directives/sym/pd01004003curr.pdf

IV. JOINT RESPONSIBILITIES

A. TRAINING

Meteorological training can be provided either by the NWS or the EACC meteorologist. Each NWS office has at least one person, typically the Fire Weather Program Leader, who is qualified to teach courses at least through Intermediate Fire Behavior (S-290). Requests for NWS training should be directed to that office's Fire Weather Program Leader or MIC. Sufficient notice should be given to allow for preparation as well as scheduling. Costs incurred by the NWS will be reimbursed by the requesting agency.

B. COORDINATION CALLS AND WEBINARS

NWS Fire Weather Program Leaders will participate in MNICS-hosted coordination conference calls, primarily in the spring fire season. This duty will be shared by the program leaders, and if they are not available, the GACC meteorologist, or another duty forecaster at a NWS office. Calls are typically scheduled at 0900 on Tuesdays and Fridays. The NWS briefer should be prepared to provide a statewide briefing highlighting significant weather trends as well as possible critical fire weather situations. Participants are asked to keep their input brief and to the point, lasting less than 5 minutes and to present weather information in a day-to-day rather than element-to-element format. When calls are held twice-weekly, weather information should go out 5 days. When calls are held once-weekly, weather information should include the next 7 days. An internet fire weather briefing page is hosted by NWS Duluth at http://www.crh.noaa.gov/dlh/?n=embrief_fire. The conference call is hosted by MNICS.

V. EFFECTIVE DATES ON THE AOP

This document will be effective approximately from March 1, 2013 to March 1, 2014.

VI. AGENCY SIGNATURES

Michael Stewart, MIC NWS Duluth _____/Signed/date
Representing all NWS offices with fire weather forecast responsibility in Minnesota

Doug Ottosen, MNICS Task Force Chairman _____/Signed/date
Signing for MN DNR and All Federal Land Managers
Management Agencies - USFS, BIA, NPS, USFWS

2013 Minnesota Fire Weather Annual Operating Plan

VII. Appendix

VII. APPENDICES (2013)

APPENDIX A:
ADDRESS AND PHONE DIRECTORY

NATIONAL WEATHER SERVICE - U.S. Department of Commerce

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National Weather Service
1733 Lake Drive West
Chanhassen, MN 55317-8581
http://weather.gov/mpx

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Dan Luna, MIC	daniel.luna@noaa.gov

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Duluth, MN 55811-1442
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National Weather Service
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Aberdeen, SD 57401
http://weather.gov/abr

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National Fire Weather Operations Coordinator
Larry Van Bussum, — Phone 208-334-9824, or 9862
National Interagency Fire Center (NIFC)
3833 South Development Avenue, Bldg 3807
Boise, ID 83705-5354 — larry.vanbussum@noaa.gov
http://www.boi.noaa.gov/firewx.htm

NWS Regional Fire Weather Program Leader
Jen Zeltwanger (Acting)
Central Region Headquarters — Jennifer.zeltwanger@noaa.gov
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Kansas City, MO 64153

Minnesota Interagency Fire Center (MIFC)

402 11th Street SE
Grand Rapids, Minnesota 55744
MIFC Dispatch (24 hours)……..218-327-4558

Tom Fasteland, **MIFC Coordinator** — tom.fasteland@state.mn.us
Phone 218-327-4583
Fax 218-327-4528

U.S. FOREST SERVICE - U.S. Department of Agriculture

Chippewa National Forest
Route 3, Box 219
Cass Lake, MN 56633
218-335-8600

Superior & Chippewa National Forest Dispatch
(All dispatching for Chippewa NF is done through Superior Dispatch)
Phone 218-327-4175 (Day and Night)
Fax 218-327-4528

Mindy Lane, Forest Dispatcher mjlane@fs.fed.us
Phone 218-327-4176

Doug Ottosen, USFS FMO dottosen@fs.fed.us
Phone 218-327-4568

Brian Jenkins USFS FMO bsjenkins@fs.fed.us
Phone 218-327-4571
Fax 218-327-4527

Fire Cache (Vacant)
Phone 218-327-4578

Eastern Area Interagency Coordination Center (EACC)

626 E. Wisconsin Avenue, Suite 500
Milwaukee, WI 53202
www.fs.fed.us/eacc

Laura McIntyre-Kelly, Center Manager mneac@dms.nwcg.gov
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Fax 414-944-3838

Steve Marien, EACC Meteorologist stephen_marien@nps.gov
Eastern Area Fire Weather Program Manager Phone: 651-290-3030 x 229
111 East Kellogg Blvd, Suite 105
St. Paul, MN 55101 Fax: 651-290-3815

Fire and Emergency Operations(vacant)
U S Forest Service, R9-RO, Attm AFM Phone 414-297-3682
310 W. Wisconsin Avenue, Suite 500 Fax 414-297-3642
Milwaukee, WI 53203-2200

NATIONAL PARK SERVICE - U.S. Department of the Interior

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36 Reservation Avenue
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U. S. FISH AND WILDLIFE SERVICE - U.S. Department of the Interior

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Charlie Blair, Refuge Manager
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Kris Larson, FMO
Litchfield NWR
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BUREAU OF INDIAN AFFAIRS - U.S. Department of the Interior

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Grand Rapids, MN 55744 — tremus@fs.fed.us

Greg Peterson
522 Minnesota Ave, Federal Building — Phone 218-751-2011, ext 408
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Bemidji, MN 56601

MINNESOTA DEPARTMENT OF NATURAL RESOURCES

MN Wildfire Information Center Home Page — http://www.dnr.state.mn.us/forestry/fire

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Minnesota Dept. of Natural Resources — Phone 218-327-4445
Minnesota Interagency Fire Center — Fax 218-327-4527
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Olin Phillips, Fire Chief — Phone 651-296-5971
Minnesota Dept. of Natural Resources — Fax 651-296-5954
Division of Forestry — olin.phillips@state.mn.us
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Fax 218-327-4527
Jean Goad, Information Officer — Phone 218-327-4564
Barb Meyer, MN DNR — Phone 218-327-4570
Diane Nygaard, Intelligence — Phone 218-327-4566

Doug Ottosen, USFS, MNICS Task Force Chairman
MN Interagency Fire Center — Phone 218-327-4568
402 11th Street SE — dottosen@fs.fed.us
Grand Rapids, MN 55744

APPENDIX B

Glossary of Meteorological Terms

A

ADDS - Automated Digital Data Service. An interactive web site at the NWS's Aviation Weather Center. Hourly surface maps are available which allow fire personnel to assess and track wind shifts, temperature, and dew points in a region.

Adiabatic Process - A thermodynamic process in the atmosphere involving warming or cooling of air normally when a parcel or layer of air moves up or down. Cooling of the air parcel occurs as it moves up and expands. The parcel warms as it descends and as the surrounding air pressure increases. The dry lapse rate of 5.5^{o} F per 1000 feet of altitude describes how unsaturated air will cool. The moist adiabatic lapse rate of 3.0^{o} F per 1000 feet describes a saturated air parcel movement.

Advection - The horizontal movement of air or of a specific component of air. Warm air advection or moisture advection that occurs may change the fire behavior.

AFD - Area Forecast Discussion. An unscheduled product from the NWS used to describe the weather features and trends for a forecast period. Although somewhat technical, it does list the features which the forecaster is following.

Air Mass - An extensive body of air having the same properties of temperature and moisture in the horizontal plane.

Anemometer - An instrument for measuring wind speed.

Anticyclone - An area of high pressure with closed, clockwise circulation. Its common name is simply a High. It is designated on a surface weather chart as a blue H.

Area Forecast Discussion (AFD) - See AFD

Atmospheric Pressure - The force exerted per unit area by the weight of the air above.

ASOS - Automated Surface Observing System - An automated weather system deployed at airports nationwide. They provide hourly reports called METARs which are plotted on surface weather maps.. These systems are primarily owned by the NWS and the Federal Aviation Administration (FAA)...

ATMU – Atmospheric Theodolite Meteorological Unit – portable equipment used by NWS Incident Meteorologists (IMET) to measure wind speed and direction aloft.

AWIPS -Advanced Weather Interactive Processing System- A powerful weather processing workstation used by forecasters at NWS Weather Forecast Offices.

AWOS - Automated Weather Observing System An automated weather system deployed at airports nationwide. They provide hourly reports called METARs which are plotted on surface weather maps.. Most systems are owned by state agencies. They are similar to ASOSs.

B

Backing Winds - Winds that change direction in a counter-clockwise direction with altitude in the vertical A south wind at the surface and an east wind at some point aloft would be an example of backing winds.

Barometer - An instrument for measuring atmospheric pressure.

Boundary Layer - The layer of air far enough above the surface to be free of frictional influences of the earth.

C

Chinook Wind - A foehn wind blowing down the eastern slopes of the Cascades, Rocky Mountains, and over the adjacent plains in the United States and Canada. In winter, this warm, dry wind causes snow to disappear with remarkable rapidity, and hence it has been nicknamed the “snow eater”. In hot dry weather, Chinook winds can quickly extend fire weather conditions to the ”extreme”.

Cirrus - A form of high cloud composed of ice crystals that do not obscure the sun to any great degree. They normally have a fibrous or wispy appearance.

Cold Front: The leading edge of a relatively cold air mass that displaces warmer air. The heavier cold air may cause some of the warm air to be lifted. If the lifted air contains enough moisture, the result may be cloudiness, precipitation, and thunderstorms. If both air masses are dry, no clouds may form. Following the passage of a cold front in the Northern Hemisphere, westerly or northwesterly winds of 15 to 30 or more miles per hour often continue for 12 to 24 hours.

Condensation - The atmospheric process by which water vapor changes into liquid form. This process releases heat.

Convection - As specialized in meteorology, atmospheric motions that are predominantly upward in the absence of wind (which distinguishes this process from advection), resulting in vertical mixing and transport of atmospheric properties. Convection is normally thought of as the process which initiates cumulus clouds and thunderstorms by heating the air from below.

Convergence - Net horizontal flow of air into an area associated with low pressure systems. If convergence occurs at the surface, upward vertical motion results. Consequently, areas of convergent winds are regions favorable to formation of clouds and development of rain.

Coriolis Force - An apparent force due to the rotation of the earth that causes a deflection of air to the right in the Northern Hemisphere as the air flows from high to low pressure. Aloft, the force balances the pressure gradient force resulting in winds flowing parallel to the height lines on an upper air chart.

Cumulonimbus - The ultimate growth of a cumulus cloud into an anvil shape, with considerable vertical growth, usually fibrous ice crystal tops, and probably accompanied by lightning, thunder, hail, and strong winds.

Cumulus - A principal, low cloud type in the form of individual cauliflower-like cells of sharp nonfiberous outline and less vertical development than cumulonimbus.

Cyclone - An area of low atmospheric pressure that has closed counter clockwise circulation. Cyclones usually bring about marked changes of weather and temperature during their passage. Other name given to cyclones are “low” or “depression”.

D

Derecho - A downburst straight line wind event from a mesoscale convective systems that produces widespread damage. The Boundary Waters Canoe Area blowdown of July 4, 1999 was a derecho.

Dew Point - The temperature to which air must be cooled at constant pressure and moisture content for saturation to occur.

Dispersion - The decrease in concentration of airborne pollutants as they spread throughout an increasing volume of the atmosphere.

Dispersion Index - A numerical value computed by multiplying the transport wind times the mixing depth or height of the mixing layer. Ranges of index values are assigned descriptive terms indicating how well the atmosphere might function at spreading out or dispersing smoke.

In Minnesota and Wisconsin the following values are used in the narrative fire weather forecasts.
<13000……Poor; 13000 to 29000……Fair; 30000 to 59000……Good; >60000……Excellent

Diurnal - Daily, especially pertaining to cyclic actions that are completed within a 24 hour period and which recur every 24 hours. The daily high and low temperature range is a diurnal cycle.

Divergence - The condition that exists when the distribution of winds within a given volume results in a net horizontal flow of air outward from the region. In divergence at lower levels, the resulting deficit is compensated by a downward movement of air from aloft. Divergence in upper levels of the atmosphere is often mentioned in Area Forecast Discussion products (AFD). Divergence in the wind flow aloft produces a compensating area of convergence near the surface resulting in the formation of low pressure centers or troughs. Divergence aloft can lead to the development of precipitation.

Dry bulb - An ordinary thermometer used to determine the ambient or existing air temperature. In a psychrometer both a dry bulb thermometer and a wet bulb thermometer are read in order to determine the relative humidity.

Dry Lightning Storm - A thunderstorm that produces little if any precipitation. Often virga is seen along with the lightning.

Drought Index: A number representing net effect of evaporation, transpiration, and precipitation in producing cumulative moisture depletion in deep duff or upper soil layers.

E

El Nino - An abnormal warming of the eastern Pacific Ocean along the west coast of South America. This pattern often disrupts normal weather cycle.

Evaporation - The transformation of a liquid into a gaseous state. Heat is lost by the liquid during the process.

F

Fire Weather - Weather conditions that influence fire ignition, behavior and suppression.

Fire Weather Watch: A term used by fire weather forecasters to notify land management agencies, usually 18 to 72 hours ahead of a situation where fire weather parameters would create dangerous fire conditions.

Foehn Wind - Pronounced "Fern" A type of general wind that occurs when stable, high pressure air is forced across and then down the lee slopes of a mountain range. The descending air is warmed and dried due to adiabatic compression. In that process, wind flowing down hill warms at the rate of 5.5^{o} per 1,000 feet. Some local names for a foehn wind are: Santa Ana, Chinook, or Mono.

Fog - A cloud at the earth's surface. Fog consists of numerous droplets of water which individually are so small that they cannot readily be distinguished by the naked eye. Three of the most common types of fog are: advection fog, radiation fog, and upslope fog.

Free Air - That portion of the atmosphere that is not modified by local surface frictional affects.

Friction Layer - The layer of the atmosphere in which the frictional force of the earth's surface exercises an appreciable influence on winds. This is generally the air within about 1500 feet of the ground.

Front - The transition zone between two air masses of different density and temperature. Fronts emerge from a low pressure center. A cold front is the lead edge for colder and more dense air. A warm front marks the northern or eastern edge of a warmer and less dense air mass. `

Frontal Inversion - An increase in temperature with height, normally near and ahead of an

advancing warm front. Warm, less dense air rides up and over the retreating colder air to the north.

G

General Winds - Large scale winds caused by the pressure gradient between high and low pressure systems but generally influenced and modified in the lower atmosphere by terrain.
GOES - Geostationary Operational Environmental Satellite. Weather satellites that remain at a fixed location 22,500 miles above the earth. East GOES is at 75^{o} W, and West GOES is at 135^{o} W GOES satellites provide a variety of weather imagery but also handle uplink and downlink communication with various observing technologies such as RAWS.
GPS Winds - Winds aloft measured by GPS navigation equipment in an aircraft.
Gradient - The change in a property between two locations. Pressure gradient is the difference in air pressure between areas of high and low pressure.
Gradient Winds - winds that flow parallel to the contours on upper air charts. This usually occurs above 1500 feet above ground level. Below that point winds cross the isobars at an angle.
Gust - A sudden, brief increase in the speed of the wind.
Gust Front - The leading edge of cold dense air flowing outward from a thunderstorm. The boundary is marked by rising air above it and downward motion behind it. Winds can be quite strong and gusty. Gust fronts are sometimes visible on Doppler radar as thin circular arcs around a thunderstorm cell or complex.

H

Haines Index: An atmospheric index used to indicate the potential for wildfire growth by measuring the stability and dryness of the air over a fire.
Hazardous Weather Outlook (HWO) - An alerting tool issued by the NWS at least every morning by 730 a.m. The HWO briefly explains potential weather hazards in the seven days ahead.

Heat Index - A discomfort index used to described the combined effects of temperature and humidity on the body's ability to cool itself.
High Clouds - Thin clouds, generally above 20,000 feet. The clouds are thin and wispy and comprised of ice crystals. Clouds in this ground include: cirrus, cirrostratus, and cirrocumulus. They are often indications of an approaching low pressure area, particularly a warm front.
High Pressure (Ridge) - An area on the surface map where atmospheric pressure measured by barometers is higher than the surrounding air. High pressure results from air descending into a region. On weather maps, highs are designated with a blue H and have closed isobars surrounding them. High pressure ridges usually are areas of cooler, subsiding air associated with quiet weather. Circulation around a high is in a clockwise direction. Over time, a subsidence inversion often forms.
HPC - Hydrometeorological Prediction Center. A part of the National Center for Environmental Prediction. The HPC is responsible for producing surface maps every three hours, forecast surface maps for every six hours, and the quantitative precipitation forecast (QPF).
Hudson Bay High - High Pressure centered near Hudson Bay, Canada. The Hudson Bay High is a contributor to fire weather problems. The air flowing clockwise around the high emerges from a cold region. As it moves south and warms, the relative humidity falls significantly. The resulting northeast winds that flow into Minnesota and Wisconsin are dry and can increase fire behavior.
Humidity - The measure of water vapor content in the air.

I

Infrared (IR) - Radiation emitted from objects in the spectrum between visible light and microwaves. Weather satellites detect levels of IR radiation and display the data in a manner such that darker grey shades represent warm temperatures and whiter colors represent cooler temperatures. In that way satellites can locate clouds and storms at various levels as well as lakes and rivers. IR imagery can also be used to detect fires.

Insolation - Radiation received from the sun at the earth's surface.

Instability - The state of the atmosphere in which the vertical distribution of temperature is such that an independent air parcel rising through the surrounding air, will become warmer than the surrounding air and will continue to rise. Unstable air contributes to increased fire behavior and better smoke dispersion.

Inversion - A condition in the atmosphere where temperature increases with increasing altitude rather than decreasing like it normally does. Inversions are of four types: Subsidence, Frontal, Radiation (nighttime), and Marine**.** Inversions inhibit smoke dispersal if low enough, and can increase fire behavior when they dissipate.

Isobar - A line of equal pressure surrounding areas of high and low pressure.

J

Jet Stream - A narrow meandering stream of high speed winds embedded in the normal prevailing westerly wind flow aloft. The jet stream is normally at about 30,000 feet but varies with seasons. Diverging air at the jet stream level often results in converging air near the earth's surface, leading to upward motion, formation clouds, and possible precipitation. There are two jet streams that cross the U.S., the polar jet, near the Canadian border, and the subtropical jet that crosses the southern tier of states.

K

Keech Byram Drought Index (KBDI): Commonly-used drought index adapted for fire management applications, with a numerical range from 0 (no moisture deficiency) to 800 (maximum drought).

L

La Nina' - The opposite of El Nino' in which abnormally cold Pacific Ocean water exists along the west coast of South America.

Lake Effect - Precipitation that occurs along the shores of the Great Lakes. The precipitation is not necessarily associated to a low pressure system but is produced by cold air moving across a relatively warmer and open lake. This unstable condition produces clouds over the relatively warmer open water. The instability can lead to precipitation, particularly snowfall.

Lapse Rate - The change of temperature with height. Normally temperature decreases with height, but it sometimes increases. This latter condition is called a temperature inversion. Lapse rates are normally expressed in negative values for temperatures that decrease with height and as positive values for inversions. The ambient lapse rate refers to the existing temperature structure of the atmosphere. The dry adiabatic lapse rate of
-5.5^{o}F per 1,000 feet is the rate at which a rising parcel of air would cool if lifted. The moist adiabatic lapse rate of -3.0^{o}F per 1,000 feet is the rate at which a saturated air parcel would cool

as it rises. The normal lapse rate of -3.5^{o}F per 1,000 feet is an average atmosphere lapse rate.
Lifted Index (LI) - An index used by the NWS to forecast thunderstorm development and severity.
Lightning - A sudden visible flash of energy and light caused by electrical discharges from thunderstorms**.**
Lightning Activity Level (LAL): A number, on a scale of 1 to 6, that reflects frequency and character of cloud-to-ground lightning. An LAL of 6 refers to dry thunderstorms. The LAL is not forecast in Minnesota.
Local Winds - Small scale convective winds of local origin cause by temperature differences. Upslope winds during the day are examples of local winds.
Low Pressure Trough - An elongated area of relatively low atmospheric pressure, usually extending from the center of a low pressure system. Troughs are areas of converging and upward-moving air.

M

METAR- Meteorological Terminal Air Report - A coded weather report from ASOS and AWOS automated airport weather stations. Reports are sent at least every hour or more often if conditions change significantly. The reports are decoded and plotted on surface maps.
Middle Clouds - Clouds ranging in altitude from 6,500 to near 20,000 feet.
Millibar (Mb)- a unit of measure for atmospheric pressure. Multiplying millibars times 0.02953 yields inches of mercury. Multiplying inches of mercury times 33.86 yields millibars. Another more universal name for a millibar is a HectaPascal (HPa).
Mixed Layer - The lowest layer of the atmosphere from the surface to the base of any temperature inversion that may exist aloft. A well mixed layer has a lapse rate close to the dry adiabatic lapse rate of -5.5^{o} F per 1,000 feet.
Mixing - The process of upward and downward motion in the atmosphere, particularly near the surface of the earth.
Mixing Height - The layer in the atmosphere from the surface to the first inversion layer. It is in this layer where vigorous mixing occurs due to convection.
NWS Spot - A web-based program for requesting and receiving spot weather forecasts.

O

Occluded Front - The front that is formed when and where a cold front overtakes a warm front or a stationary front.
Outflow - Cold, denser air that descends from the base of a thunderstorm and then spreads out in all directions. Outflow can travel several miles ahead of the thunderstorm and create gusty erratic winds unexpectedly.
Outflow Boundary - The leading edge of thunderstorm outflow. If these boundaries meet boundaries from other thunderstorms, new thunderstorm development is possible. Outflow boundaries are sometimes visible on weather radar as thin, curved lines surrounding a thunderstorm.

P

Palmer Drought Severity Index - An index used to gage the severity of drought conditions by using a water balance equation to track water supply and demand. This index is calculated weekly by the NWS.
Pibal - Pilot balloon. A method used by an Incident Meteorologist (IMET) at a fire to measure

the winds aloft. The IMET tracks the ascending balloon with a theodolite noting azimuth and elevation every minute. He later uses these angles to calculate the winds. Launched with equipment contained in the ATMU.

Pressure Gradient - The difference between the air pressure in one area and the air pressure in another. The difference between High and Low pressure areas can be very small and result in light winds. Or the air pressure differences can be large, resulting in strong winds flowing from the High to the Low.

Profiler - A sampling device used to measure wind speeds aloft. A network of profilers is in the Midwest. The most northern installation is at Wood Lake, Minnesota. Profiler data maps are available on the internet.

Q

QPF - Quantitative Precipitation Forecast - A forecast of the rainfall amount that might be measured in a rain gage randomly placed in an area.

R

Radiational Cooling - The net loss of heat due to infrared radiation. Radiational cooling cools the ground and the air immediately above. Over time, radiational cooling helps to develop a nocturnal inversion, and that leads to poor smoke dispersion.

Radiosonde - an instrument carried aloft by balloon and tracked by ground equipment. The instrument sends back temperature, humidity, and pressure. Ground equipment helps to calculate wind speeds.

RAOB - Radiosonde Observation. A collection of information sent back from a radiosonde instrument. The data are used to create a plotted sounding which shows the temperature, humidity, and wind structure of the air aloft. RAOBs are used as basic information for the atmospheric forecast models and for determining smoke management parameters.

Red Flag Warning - Term used by fire weather forecasters to alert forecast users to an ongoing or imminent critical fire weather pattern.

Reflectivity - The ability of a radar target to return energy; used to estimate precipitation intensity and rainfall rates. Reflectivity imagery this that most often display on NWS web sites and on TV weathercasts. Cooler blue shades usually indicate light precipitation while warmer, red hues imply stronger thunderstorms.

Relative Humidity (RH) - The ratio of the amount of moisture in the air, to the maximum amount of moisture that air would contain if it were saturated. The ratio of the actual vapor pressure to the saturated vapor pressure.

Remote Automatic Weather Station (RAWS) - An apparatus that automatically acquires, processes, and stores local weather data for later transmission to the GOES Satellite, from which the data is re-transmitted to an earth-receiving station for use in the National Fire Danger Rating System.

Ridge - An elongated area of High Pressure.

Roll Cloud.- A horizontal, tubular cloud that may be seen on the leading edge of an outflow from a thunderstorm.

RUC - Rapid Update Cycle. A short term atmospheric forecast model that uses recent surface observations (METARs), satellite-calculated winds and temperatures, Doppler radar winds, and other information from commercial aircraft.

S

Severe Weather Statement (SVS) - A text product issued by the local NWS office during severe weather as an update to a Severe Thunderstorm Warning or Tornado Warning. The SVS gives detailed information about when the leading edge of severe weather, gusty winds, hail, and rain will pass designated locations.

Sea Breeze - A local wind that flows from a large body of water toward land. The sea breeze results from the land heating up, causing the air to rise convectively. As this happens, air from the cooler water flows inland. Sea breezes are often noted along Lake Superior, especially in the spring. Sea breezes can be opposite to the established flow in the area, or it can enhance the local wind if blowing in the same direction as the local winds.

Security Weather Watch - Observers are posted at one or more strategic locations in the proximity of a fire to detect critical weather changes that might significantly affect the fire and to report those changes to fire personnel.

Short Term Forecast - Sometimes called a NOWCAST. A short text product issued by the local NWS office to supply detail on weather such as non-severe thunderstorms that is or soon will be occurring at designated locations.

Short Wave - A kink in the broad scale upper flow. The east side of short waves area areas of rising motion, while the west side are areas of downward motion. Forecasters track short waves since short waves can often help to initiate or strengthen storms.

SkewT - A special graph for plotting upper air soundings or RAOBS. Forecasters use SkewTs to determine atmospheric instability as well as to calculate smoke management parameters. The temperature axis is shifted or skewed at an angle rather than being at right angles to the other axis as is normally done. *See also Stuve.*

Slope Winds - Small scale convective winds that occur due to local heating and cooling of a natural incline of the ground.

Smoke Management: - Application of fire intensities and meteorological processes to minimize degradation of air quality during prescribed fires.

Sounding - See RAOB

SPC - Storm Prediction Center - The office that issues Severe Thunderstorm and Tornado Watches. SPC also issues a daily fire weather related message on the potential for severe fire weather conditions.

Spot Weather Forecast: - A special forecast issued to fit the time, topography, and weather of each specific fire. These forecasts are issued upon request of the user agency and are more detailed, timely, and specific than zone forecasts.

Squall line - Any non-frontal line or narrow band of active thunderstorms extending across the horizon. It is of importance to fire behavior due to accompanying strong gusty winds and the possibility of such a line passing between regular weather observation stations without being reported.

Stability - The state of the atmosphere in which the vertical distribution of temperature is such that an air parcel will resist vertical displacement from its level.

State of Weather - A brief description of current weather that expresses the amount of cloud cover, kind of precipitation, and/or restrictions to visibility being observed at a weather observation site.

Stratosphere - The layer of the atmosphere between the troposphere and the mesosphere where the air is usually stable.

Stuve Diagram - (Pronounced STOO vee) A type of graph used to plot upper air soundings or RAOBs and from which smoke management parameters can be calculated. *See also SkewT.*

Subsidence - An extensive sinking motion of air in the atmosphere, most frequently occurring in

high pressure areas of polar origin. The subsiding air is warmed by compression and becomes more stable as a subsidence inversion develops. Of particular importance is the heating and drying of the air.

Subsidence Inversion - A temperature inversion that forms under high pressure. The inversion lowers with time.

Subtropical High - The semi-permanent area of high pressure centered in the south Atlantic and Caribbean areas.

Surface Wind - The wind measured at 20 feet above the average top of the local vegetation. It is often a combination of the local and general winds.

T

Thermal Belt - An area of mountainous slope (characteristically the middle third), where the top of the radiation inversion intersects the slope. That area typically experiences the least variation in diurnal temperature variation and has the highest average temperature, and thus the lowest relative humidity. Its presence is most evident during clear weather with light wind.

Thunderstorm - Localized storm characterized by one or more electrical discharges.

Transport Winds - The average wind speed and direction of the horizontal wind within the mixing layer.

Troposphere - The layer of the atmosphere from the earth's surface up to the tropopause, characterized by decreasing temperature with height (except, perhaps in thin layers, called inversions), vertical wind motion, appreciable water vapor content, and sensible weather (clouds, rain, etc.)

Trough - An elongated area of low pressure. Troughs are regions of converging air at low levels which in turn results in upward vertical motion. See also Upper level disturbance, short wave.

Turbulence - Irregular motion of the atmosphere usually produced when air flows over a comparatively uneven surface such as the surface of the earth; or when two currents of air flow past or over each other in different directions or at different speeds.

U

Upper Level Disturbance - See Short Wave. A general term for any large scale or mesoscale disturbance capable of producing upward motion (lift) in the middle or upper parts of the atmosphere. Such disturbances can help initiate vertical motion or enhance existing vertical motion.

V

Vorticity - A measure of the local rotation in a fluid flow. In weather analysis and forecasting, it usually refers to the vertical component of rotation (i.e. rotation about a vertical axis) and is used most often in reference to synoptic scale or mesoscale weather systems. By convention, positive values indicate cyclonic rotation.

Veering Winds - Winds which shift in a clockwise direction with time at a given location (e.g. from southerly to westerly), or which change direction in a clockwise sense with height (e.g. southeasterly at the surface, turning to southwesterly aloft). The latter example is a form of directional shear which is important for tornado formation. Contrast with backing winds.

Virga - Streaks or wisps of precipitation falling from a cloud but evaporating before reaching the ground. In certain cases, shafts of virga may precede a microburst. Virga may also be present in dry thunderstorms which produce "dry lightning".

W

Warm Front - The leading edge of a relatively warm air mass which moves in such a way so that warm air displaces colder air. Winds associated with warm frontal activity are usually light, and mixing is limited. The atmosphere is relatively stable near a warm front when compared to the air near a cold front.

Weather Information and Management System (WIMS): An interactive computer system designed to accommodate the weather information needs of all federal and state natural resource management agencies. Provides timely access to weather forecasts, current and historical weather data, the National Fire Danger Rating System (NFDRS), and the National Interagency Fire Management Integrated Database (NIFMID).

Wet Bulb Depression - The difference between the wet-bulb and dry-bulb temperatures as measured by a psychrometer. The greater the web bulb depression, the drier the air.

Wet Bulb Temperature - The lowest temperature to which air can be cooled by evaporating water into it at a constant pressure when the heat required for evaporation is supplied by the cooling of the air. It is measured by the wet-bulb thermometer, which usually employs a wetted wick on the bulb as a cooling devise through the process of evaporation. The drier the air, the more evaporation from the wet bulb of a psychrometer can occur. The wet bulb temperature is an indicator of the water vapor in the air. Relative humidity and dew point are calculated from tables into which the dry bulb and wet bulb temperatures are used an inputs.

WSR-88D - The identifier for National Weather Service Doppler radar. Weather Surveillance Radar deployed in 1988 with Doppler capability.

APPENDIX C

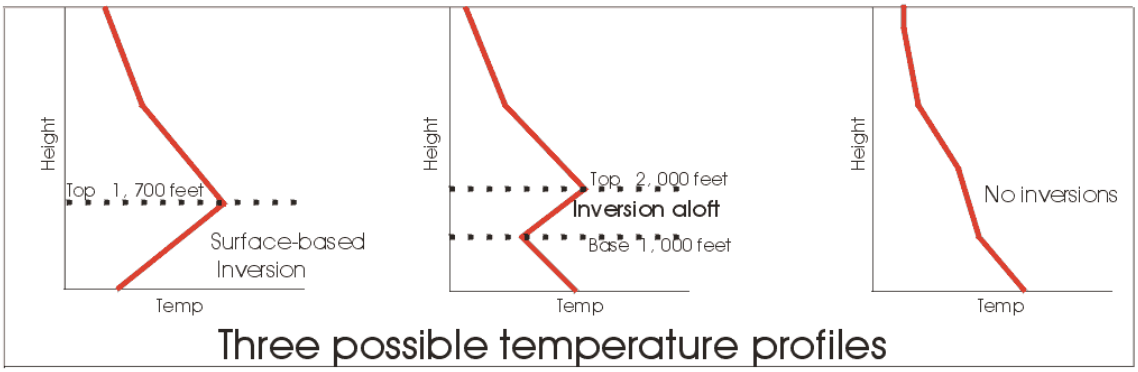
SMOKE MANAGEMENT

The Clean Air Act requires land management agencies to address the issue of smoke management in its prescribed burns. The goal is to burn in atmospheric conditions that would encourage smoke to rise to such a level that the smoke is dispersed as much as possible to reduce a number of health and safety risks near the fire.

A Minnesota Smoke Management Plan (SMP) was created in the year 2000 and should be considered the source document for any questions regarding the requirements or practices of smoke management in Minnesota. The Plan was updated in 2008.

The National Weather Service will support the smoke management efforts of federal, state, and local agencies as well as organizations involved in such burning. The NWS will provide three (3) parameters used in smoke management in its Fire Weather Planning Forecasts. The NWS will also include these parameters, upon request of the land agency, in spot forecasts.

The three weather parameters of smoke management forecasts are mixing layer (or depth), transport winds, and dispersion index. For smoke management purposes, the mixing layer is usually considered the lowest layers of the atmosphere bounded by the earth's surface and the bottom of any temperature inversion which may exist aloft. If a temperature inversion is based at the surface, then there is little if any mixed layer. A temperature inversion would serve to trap smoke at low levels or would prevent sufficient lofting of smoke to a level where winds would



dilute or transport it away from the area. See Figure 16 below.

Figure 16. Three upper air temperature profiles which affect smoke dispersal differently. a) a surface-based inversion is an absolutely stable condition that traps smoke and prevents lofting. b) An elevated inversion is unstable or neutral and allows limited smoke rise, but the smoke will stop rising at the base of the inversion aloft. c) When no inversions are present, smoke is free to rise. However, the existing (ambient) lapse rate will determine the rate of rise and the plume characteristics.

The transport wind is defined as the average wind speed and direction through the mixing layer.

In forecasts provided by the NWS, the transport wind will be provided in mph and the height of the mixed layer will be in feet agl.

The transport wind may suggest the need for surveillance or resource location at downstream areas for the purpose of minimizing the danger posed by spotting due to firebrands and to determine the impacts of smoke on a sensitive area.

The Dispersion Index is detailed in the Minnesota Smoke Management Plan (SMP) in section 4.2.2. The index is intended to serve as a single adjective index which describes how smoke will disperse on that day. The Dispersion Rate is given by the following formula as defined in the Minnesota Smoke Management Plan:

Dispersion Index = (Mixing Height in feet) x (Transport Wind in knots)

The SMP contains guidelines for using the index and should be consulted for those details. The Minnesota Smoke Management Plan (SMP) suggests the following interpretation of the values:

Dispersion Index	**Dispersion Rate**
< 13,000	Poor
13,000 - 29,999	Fair
30,000 - 59,999	Good
60,000 or greater	Excellent

The National Weather Service uses a variety of units of measure for wind and height. To minimize confusion and to make the conversion of units easier, the following conversion factors will prove helpful.

Multiply	**By**	**To get**
Feet	0.308	Meters
Feet	0.0152	Chains
Statute Miles	1609.34	Meters
Statute Miles	1.60934	Kilometers
Statute Miles	0.8684	Nautical Miles
Statute Miles	80	Chains
Nautical Miles	0.6080	Feet
Nautical Miles	1.152	Statute Miles
Nautical Miles	1853.25	Meters
Nautical Miles	1.85325	Kilometers
Chains	66	Feet
Chains	20.12	Meters
Chains	0.0125	Statute Miles
Meters	3.281	Feet
Meters	0.0497	Chains
Meters	0.00062	Statute Miles
Meters	0.00054	Nautical Miles
Kilometers	3280.84	Feet
Kilometers	0.6214	Statute Miles
Kilometers	0.5396	Nautical Miles
Knots	1	Nautical Miles Per Hour
Knots	1.152	Statute MPH
Knots	1.689	Feet Per Second
Knots	0.515	Meters Per Second
Knots	1.853	Kilometers Per Hour
Statute MPH	0.868	Knots
Statute MPH	1.467	Feet Per Second
Statute MPH	0.447	Meters Per Second
Statute MPH	1.609	Kilometers Per Hour
Statute MPH	88	Feet Per Minute
Kilometers Per Hour	0.278	Meters Per Second
Kilometers Per Hour	0.540	Knots
Kilometers Per Hour	0.621	Miles Per Hour
Kilometers Per Hour	0.911	Feet Per Second
Meters Per Second	3.6	Kilometers Per Hour
Meters Per Second	1.943	Knots
Meters Per Second	2.237	Miles Per Hour
Meters Per Second	3.281	Feet Per Second
Meters Per Second	196.85	Feet Per Minute

APPENDIX D

HAINES INDEX

The NWS will provide the Haines Index in Fire Weather Planning Forecasts.

What is the Haines Index?

The Haines Index combines the effects of dry air and instability to determine the potential for large fire growth. Its purpose is to identify weather conditions that may allow an existing fire to spread rapidly or exhibit extreme fire behavior. It should NOT be used to predict the potential or probability for wildfires to ignite. The Haines Index is most applicable to plume-dominated fires. The Haines Index does not account for wind.

The Haines Index contains two components, one to assess the dry air, and the other to measure the instability. Dry air affects fire behavior by lowering fuel moisture, which increases the amount of fuel available to the fire. Instability is caused by warming the lower levels of the atmosphere, cooling the higher levels, or by a combination of the two processes. An unstable air mass promotes the formation of rising currents of air and thus increases the vertical extent of a smoke column. Wildfires that burn in a dry, unstable environment can become plume-dominated and are often able to generate their own strong surface winds. Ground elevation will determine which of three levels in the atmosphere will be used to compute the Haines Index. In Minnesota, the mid-level layer between 850 mb (around 5000 feet agl) and 700 mb (around 9000 feet agl) will be used.

Computing the Haines Index

Haines Index = Stability + Moisture = A + B

Stability Term = 850 MB Temperature - 700 MB Temperature
Let A equal the following values according to the temperature differences

A = 1 when stability term is 5 degrees C or less
A = 2 when stability term is 6 to 10 degrees C
A = 3 when stability term is 11 degrees C or more

Large positive values of the stability term indicate an unstable layer of the atmosphere near the earth's surface. Negative values indicate a temperature inversion.

Moisture Term = 850 MB Temperature - 850 MB Dew Point Temperature

B = 1 when moisture term is 5 degrees C or less
B = 2 when moisture term is 6 to 12 degrees C
B = 3 when moisture term is 13 degrees C or more
The greater the value of this term, the drier the air is.

Significance of the Haines Index values

2 or 3	**Very Low**
4	**Low**
5	**Moderate**
6	**High**

An example calculation

850 MB Temperature = 20 degrees C
850 MB Dew Point = 15 degrees C
700 MB Temperature = 12 degrees C
Haines Index = Stability (A) + Moisture (B)
From the tables above
850 MB Temp - 700 MB Temp = 20 - 12 = 8 Stability is between 6 and 10, so let A = 2
850 MB Temp - 850 MB Dew point = 20 - 15 = 5 Moisture is less than 6, so let B = 1

A + B = 2 + 1 = 3.

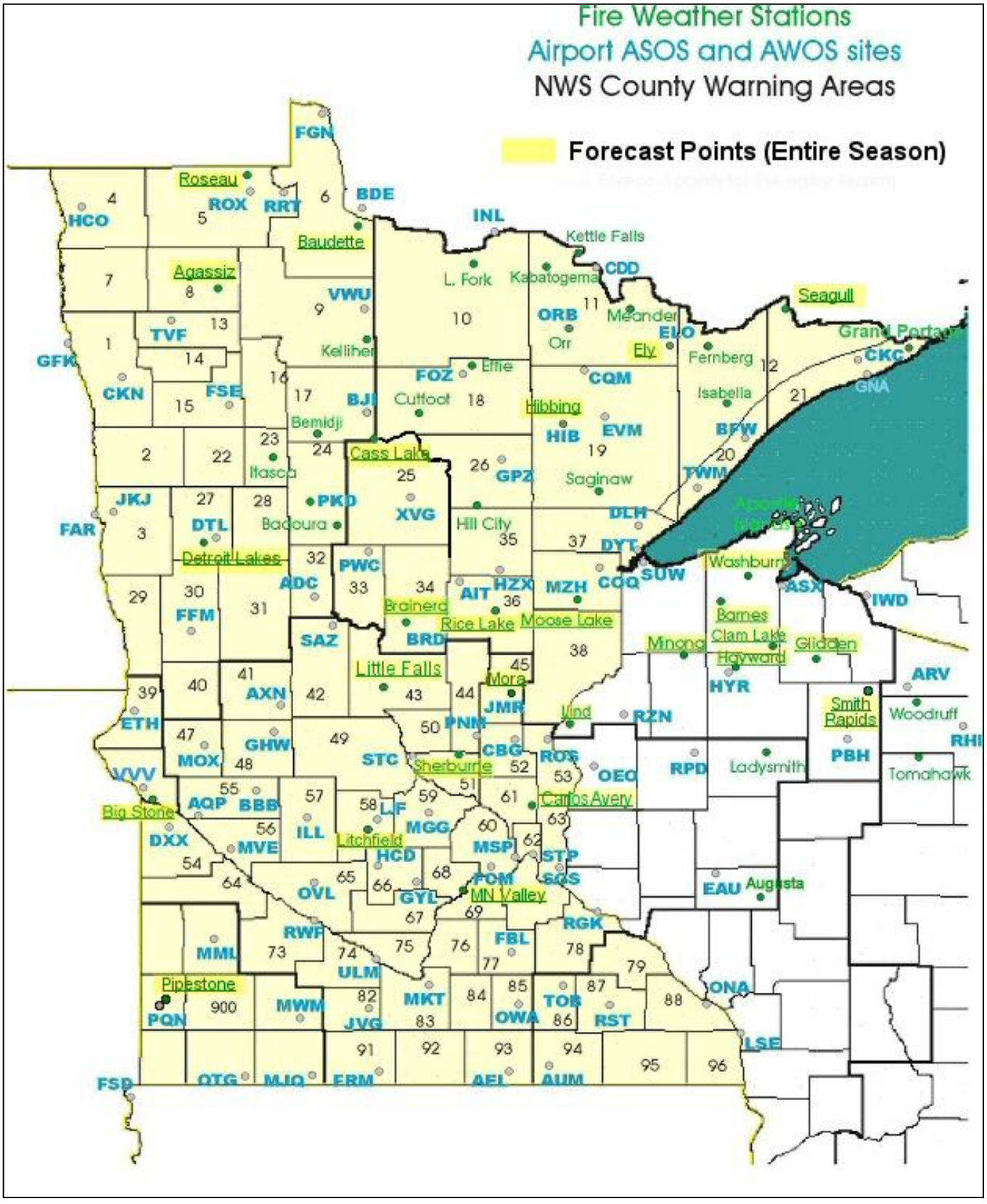
An Index value of 3 corresponds to a "Very Low" category. The conclusion is that extreme fire behavior would not be expected on this day.

A weakness of using the Haines Index is that the stability and moisture terms are calculated at two fixed levels (850 and 700 MB). At times, making the calculations at slightly different levels could lead to a significantly different Haines Index.

APPENDIX E

Zones, Counties, Cities, and Weather Stations

Zones, County Warning Areas, Fire Weather Stations and Airport ASOS and AWOS Weather Observation sites. A list of stations, zone names, and zone numbers is on the next page.

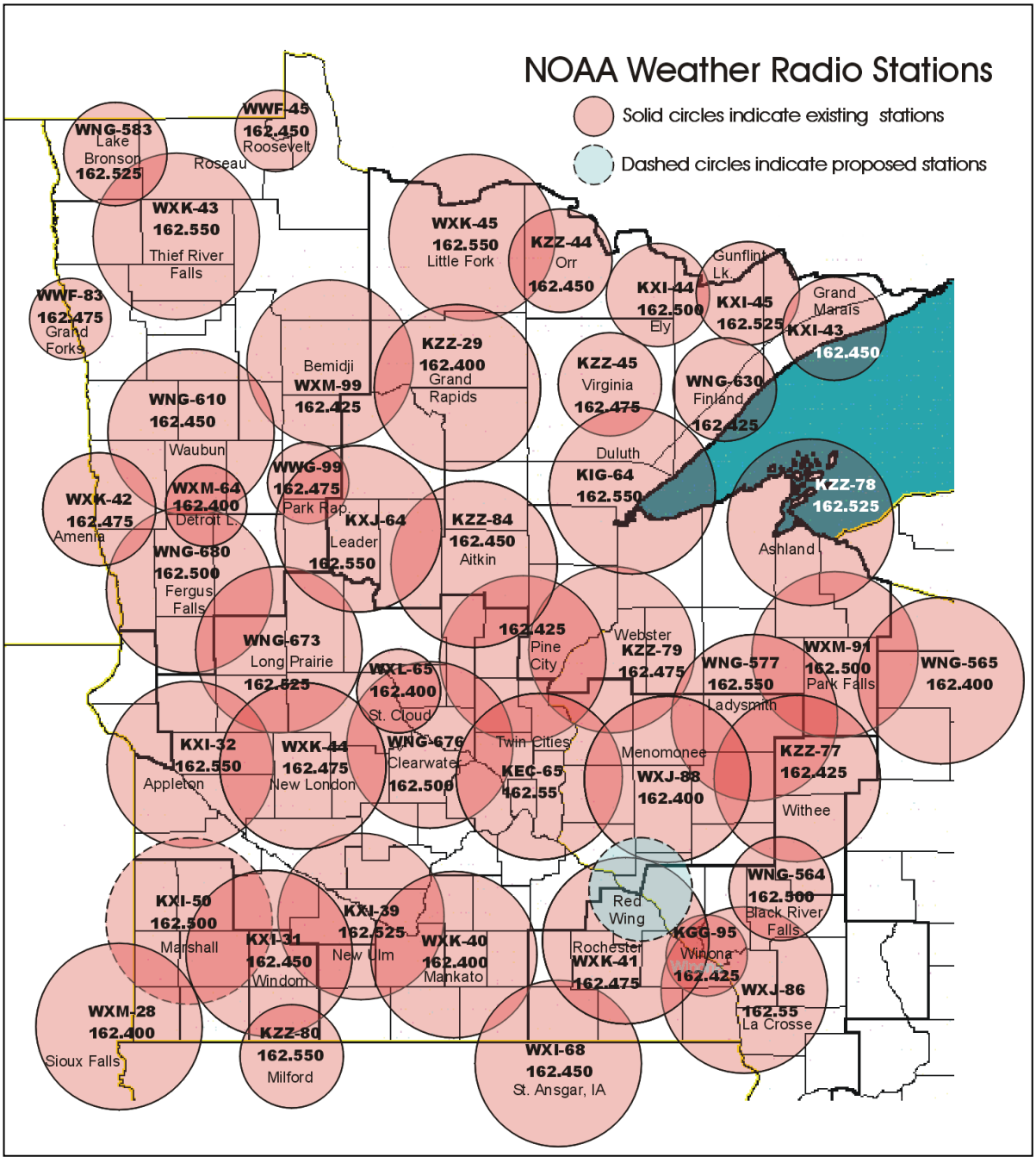


Zones, Counties, Cities, and Weather Stations

ZONE	City	Zone Name
1	Crookston	West Polk
2	Ada	Norman
3	Moorhead	Clay
4	Hallock	Kittson
5	Roseau/Greenbush	Roseau
6	Baudette	Lake of the Woods
7	Argyle	W. Marshall
8	Grygla	E. Marshall
9	Waskish	N. Beltrami
10	International Falls	Koochiching
11	Ely	N. St. Louis
12	BWCAW	N. Cook/Lake
13	Thief River Falls	Pennington
14	Red Lake Falls	Red Lake
15	Erskine	E. Polk
16	Clearbrook	N. Clearwater
17	Bemidji	S. Beltrami
18	Effie	N. Itasca
19	Hibbing	C. St. Louis
20	Finland/Two Harbors	Northshore/S. Lake
21	Grand Marais/ Grand Portage	Northshore/S. Cook
22	Mahnomen	Mahnomen
23	Bagley	S. Clearwater
24	Park Rapids	Hubbard
25	Cass Lake	N. Cass
26	Grand Rapids	S. Itasca
27	Detroit Lakes	W. Becker
28	Osage	E. Becker
29	Breckenridge	Wilkin
30	Fergus Falls	W. Otter Tail
31	Ottertail	E. Otter Tail
32	Wadena	Wadena
33	Leech Lake	S. Cass
34	Brainerd	Crow Wing
35	Hill City	N. Aitkin
36	Aitkin	S. Aitkin
37	Duluth/Cloquet	Carlton/S. St. Louis
38	Hinckley	Pine
39	Wheaton	Traverse
40	Elbow Lake	Grant
41	Alexandria	Douglas
42	Long Prairie	Todd
43	Little Falls	Morrison
44	Onamia	Mille Lacs
45	Mora	Kanabec
46	Ortonville	Big Stone
47	Morris	Stevens
48	Glenwood	Pope
49	St. Cloud	Stearns
50	Sauk Rapids	Benton
51	Elk River	Sherburne
52	Cambridge	Isanti
53	Taylors Falls	Chisago
54	Madison	Lac Qui Parle
55	Benson	Swift
56	Montevideo	Chippewa
57	Willmar	Kandiyohi
58	Litchfield	Meeker
59	Buffalo	Wright
60	Minneapolis	Hennepin
61	Anoka	Anoka
62	St. Paul	Ramsey
63	Stillwater	Washington
64	Granite Falls	Yellow Medicine
65	Renville	Renville
66	Glencoe	McLeod
67	Gaylord	Sibley
68	Waconia	Carver
69	Shakopee	Scott
70	Hastings	Dakota
71	Lake Benton	Lincoln
72	Marshall	Lyon
73	Redwood Falls	Redwood
74	New Ulm	Brown
75	St. Peter	Nicollet
76	Montgomery	Le Sueur
77	Faribault	Rice
78	Zumbrota	Goodhue
79	Wabasha	Wabasha
80	Slayton	Murray
81	Windom	Cottonwood
82	St. James	Watonwan
83	Mankato	Blue Earth
84	Waseca	Waseca
85	Owatonna	Steele
86	Dodge Center	Dodge
87	Rochester	Olmsted
88	Winona	Winona
89	Worthington	Nobles
90	Jackson	Jackson
91	Fairmont	Martin
92	Blue Earth	Faribault
93	Albert Lea	Freeborn
94	Austin	Mower
95	Preston	Fillmore
96	Caledonia	Houston
97	Pipestone	Pipestone
98	Luverne	Rock

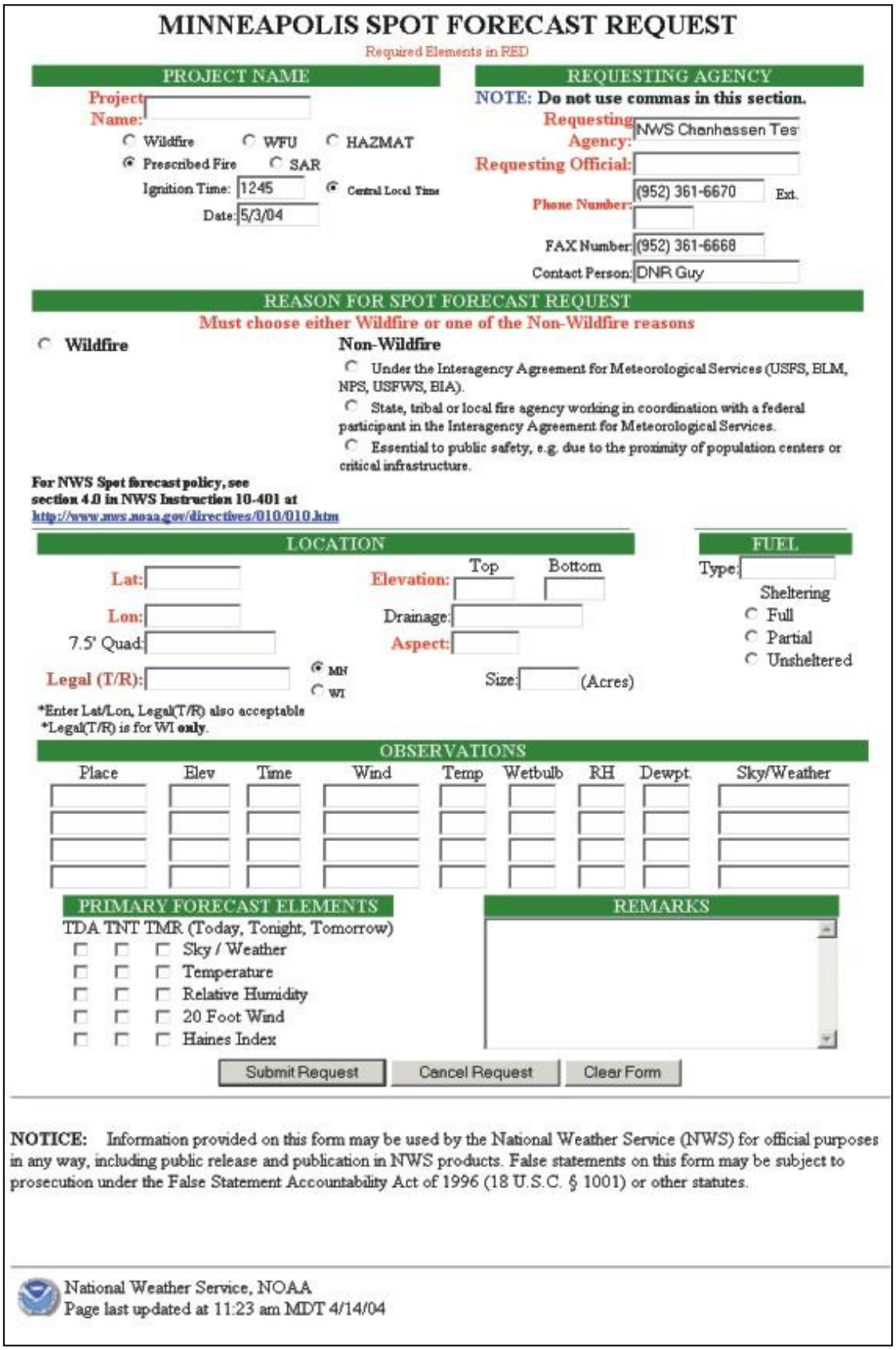
APPENDIX F

NOAA WEATHER RADIO STATIONS



NOAA Weather Radio transmitter sites. The circles indicate a radius within which the tone alert should be available. Actual availability may vary due to terrain, weather conditions, or other reasons. Smaller circles indicate lower-powered transmitters. Red, or blue colored circles indicate existing stations or those which should be available in the near future. Frequencies are shown in megahertz.

Appendix G



MINNEAPOLIS SPOT FORECAST REQUEST

Required Elements in RED

PROJECT NAME

Project Name:

○ Wildfire ○ WFU ○ HAZMAT
◉ Prescribed Fire ○ SAR

Ignition Time: 1245 ◉ Central Local Time
Date: 5/3/04

REQUESTING AGENCY

NOTE: **Do not use commas in this section.**

Requesting Agency: NWS Chanhassen Tes
Requesting Official:
Phone Number: (952) 361-6670 Ext.
FAX Number: (952) 361-6668
Contact Person: DNR Guy

REASON FOR SPOT FORECAST REQUEST

Must choose either Wildfire or one of the Non-Wildfire reasons

○ **Wildfire**

Non-Wildfire

○ Under the Interagency Agreement for Meteorological Services (USFS, BLM, NPS, USFWS, BIA).
○ State, tribal or local fire agency working in coordination with a federal participant in the Interagency Agreement for Meteorological Services.
○ Essential to public safety, e.g. due to the proximity of population centers or critical infrastructure.

For NWS Spot forecast policy, see section 4.0 in NWS Instruction 10-401 at
http://www.nws.noaa.gov/directives/010/010.htm

LOCATION

Lat:
Lon:
7.5' Quad:
Legal (T/R):
◉ MN ○ WI

Elevation: Top Bottom
Drainage:
Aspect:
Size: (Acres)

*Enter Lat/Lon, Legal(T/R) also acceptable
*Legal(T/R) is for WI **only**.

FUEL

Type:
Sheltering
○ Full
○ Partial
○ Unsheltered

OBSERVATIONS

Place	Elev	Time	Wind	Temp	Wetbulb	RH	Dewpt.	Sky/Weather

PRIMARY FORECAST ELEMENTS

TDA TNT TMR (Today, Tonight, Tomorrow)

☐ ☐ ☐ Sky / Weather
☐ ☐ ☐ Temperature
☐ ☐ ☐ Relative Humidity
☐ ☐ ☐ 20 Foot Wind
☐ ☐ ☐ Haines Index

REMARKS

Submit Request | Cancel Request | Clear Form

NOTICE: Information provided on this form may be used by the National Weather Service (NWS) for official purposes in any way, including public release and publication in NWS products. False statements on this form may be subject to prosecution under the False Statement Accountability Act of 1996 (18 U.S.C. § 1001) or other statutes.

National Weather Service, NOAA
Page last updated at 11:23 am MDT 4/14/04

[Instructions on How to Use the Internet Spot Forecast Request Form]

From the Fire Weather Main Page on any National Weather Service web site, click **on Internet Request Spot Form**. The Spot Forecast Request form will appear. This page auto-updates every minute, so as new spot forecasts are requested or their status changes, you immediately see the changes on the page. We call this the monitoring page. It should be noted that Spot Forecasts on this Web Page are viewable by the public.

A nice feature available now is that Spot Forecasts can be viewed in a KML file in Google Earth from the following NWS webpage http://radar.srh.noaa.gov/fire/. Simply click on the Spot Forecast Request KML link on the right side of page to access a National Map of Spot Forecasts.

Some of the features on the Internet Spot Forecast Request Form Page include:

A) The current date with arrow keys allowing you to step back or forward to a particular date. A calendar is also available, which will allow you to see how many spot forecasts were issued on a certain date.

B) A map of the NWS office's fire weather area of responsibility. A small box will appear indicating the location of any spot requests. The box is colored coded to indicate if the spot forecast is pending (green), which means you have submitted the request and the NWS is working on the forecast. A purple box indicates the NWS has sent you a question with respect to the spot forecast. A red box on the map means the spot forecast is complete and you can either click on the red box or in the Name/Ignition Time/Status Box to see the forecast.

C) A link at the top of the monitoring page will take you back to the NWS Fire Weather Page. So to submit a spot request online, simply click on SUBMIT A NEW SPOT REQUEST. You will now be taken to the NWS SPOT FORECAST REQUEST page.

Information Page You Will Be Filling In

*** It is important to note that the elements colored in red are required fields! ***

Let's look at the information fields on this page...

1 _ Project Name: If your fire has a name, go ahead and put it in. Otherwise, let's say the fire is 5 miles west of Litchfield, MN. Go ahead and enter in 5W of Litchfield, MN. Put in something that you will be able to reference on the Spot Request Page because this is a required field.

* select the type of project. If it is a prescribed burn, please enter in the Ignition Time (using the 24 hour clock) and Date. The form defaults to an ignition time about ½ hour into the future. If it is a wildfire, remove the default ignition time.

2 _ Requesting Agency: The Requesting Agency name and phone number are required. Fax number and contact person are optional, but we consider those very important if we have any questions or a breakdown in dissemination capabilities. You will only need to enter your agency name, phone/fax numbers, and your name the first time you request a spot forecast. After that, it will be filled in with the same information as your last request, assuming you use the same computer. Please note that no other people other than you and the NWS will see this information. Only the name of the requesting agency is shown.

You will also have to choose the Reason for the Spot Forecast Request Wildfire or Non-wildfire. If a non-wildfire, you must also click on one of the three justifications. See Page 14 of the Minnesota Fire Weather AOP for more details.

3 _ Location: You have a couple of options on this one, but they are important with respect to having the location appear on the map. Proper location data will give us detailed map information on the location of the fire and the terrain in the area.

* Enter the Latitude and Longitude of the fire (you can either specify degrees like 45.1486 or degrees/minutes/seconds like 45 13 34).

4 _ Elevation: The top and bottom elevations of the fire are required. You can just enter the numbers and do not need to mention the word feet. If the burn or fire is on flat ground, you can enter a value in only one of the boxes, preferably the one labeled Top.

* Drainage is optional and once again references the river drainage basin the fire is in. If you do not know it, go ahead and just submit the request anyway.

5 _ Aspect:. Use direction references such as N, NE, E, SE, S, SW, W, NW. If the fire or burn is in flat terrain, you can type in FLAT.

6 _ Size: Enter the acreage if known, but it is an optional field.

7 _ Fuel: Please indicate the type of fuel, either using fuel model numbers, or better yet a description of the fuel such as grass, slash, timber, etc. Also, if you can indicate the amount of fuel sheltering, it helps us in providing accurate wind forecasts.

8 _ Observations: Current weather observations can improve the quality of a spot forecast. Please enter in the information with respect to the observation. For each observation we need to know where it is in relation to the burn, the elevation in feet, and the time (preferably using a 24 hour clock). The wind (in mph) can be specified as N12 Gust 25 or North at 10 for example. You must specify if the wind is a 20 foot wind or an eye-level wind. The temperature and wet bulb values (in degrees F) should be entered and the RH (in percent) and dew point (in degrees F) can also be entered if known. If you enter a temperature and wet bulb, the RH and dew point will be calculated for you. Finally, any remarks about clouds, weather, or other important information should be entered in the final box.

9 _ Primary Forecast Elements: Tell us what the forecast elements you need, or are particularly important to the burn. There are six parameters listed for you. Select which ones you want a forecast for, and the time period(s) you would like as well (available times are Today, Tonight, and Tomorrow).

10 _ Remarks: Information such as wind direction or change in wind direction or speed which would adversely affect the burn is very useful. Any other information which you feel would be of use to the forecaster preparing the forecast is helpful. It is here where you would make a request for Hysplit trajectory parcel forecasts, which may be of value for smoke management. To obtain this information, simply add to the REMARKS block of the request Hysplit<space>your email

address. An example would be Hysplit jack.pine@state.mn.us. The Hysplit run will then be emailed to you. At this time, the lowest trajectory level available is 500 meters with others at 1000 and 3000 meters. Hysplit may be of more value in larger burns when impacts would extend beyond 6 miles. It may also not be appropriate in situations with low mixing heights – under an inversion.

11 _ Action: You now have three options. You can Submit Request, Cancel Request, or Clear Form. When you hit Submit Request, various checks are performed on the data you have entered. Some problems make it impossible for your request to be accepted (for example, if you forget to enter a name for the burn), while others will produce warnings and messages for your information. For example, even though drainage name is not required, it will still ask you if you know what it is. You do not have to answer this question. If an error is found, you will be taken to a page that describes the errors or minor problems. You can click on Go Back and Fix and have the opportunity to make the necessary changes. You can click on Submit Request Anyway, but we may send back a question or call you. You do have one more option and that is to Cancel Request.

Other Important Information

* After you have submitted a spot forecast request, an individualized spot forecast web page becomes available for that burn. The page automatically updates every minute so that as new information becomes available for the burn, you see it immediately. Detailed maps of the area around the burn are generated and displayed when they become available.

* Once the forecast is COMPLETED and made available to you, the page will not update anymore. Thus, if we update the forecast, we would have to call you to inform you of the upcoming change, since the page no longer updates or has a way to inform you that a change has been sent. When you go back into the forecast, the only way you might pick up on the changed forecast is at the top of the page it shows the time that the spot was requested and the time it was issued. The issue time will have changed. Keep in mind that "sensitive" information like your name, phone number, and the exact location of the burn are NOT visible to others - only to you and the NWS.

* If we have questions about your request, we may send you back a question about it. If this happens, the Status Box will show the word QUESTION and the box on the map will turn purple. Click on this and you will see a big red box in the forecast page with our question. Usually there is some problem with the request that you can probably fix (use the CHANGE REQUEST link to do this, make your changes if necessary, then submit the request once again. The purple box will return to green and the word QUESTION will change back to PENDING) or you can call us.

* When your forecast is complete, it will show up in the spot forecast web page (clicking on the red box in the map or COMPLETED in the Status Box can access the spot). On the forecast page a Feedback box will appear where you can provide us information with respect to how the forecast worked out, perhaps later in the day or several days down the road. This feedback helps us to improve. Simply type in your feedback into the box and click on Send Feedback.

* At the bottom of the forecast page are links for actions that you can take. For example, you can go "Back to Spot List" to return to the monitor page. If you need to delete a request, simply click

on "Delete Request".

* You can also click on "Copy Info to New Spot Request". This is helpful for burns that last over several days. Rather than having to re-enter the data in the form to get a new forecast, you can view the previous spot request and then copy all the location parameters to a new request using this link. This will save you some time when filling out the request form.

- Remember, you can also call the servicing NWS office in you have any questions.